UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

March 4, 2003

Magalie R. Salas, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

RE: Endangered Species Act Section 7 Consultation: Biological Opinion on Interim Operation of the North Fork (FERC No. 2195) and Oak Grove (FERC No. 135) Hydroelectric Projects through 2006. NOAA Fisheries Consultation F/NWR/2002/00477.

Dear Secretary Salas:

Enclosed is the final biological opinion prepared by the National Marine Fisheries Service (NOAA Fisheries) on the Federal Energy Regulatory Commission's (FERC) proposed operation of the Clackamas River Hydroelectric Project through 2006, including the proposed license license amendment and interim conservation measures. This document represents NOAA Fisheries' biological opinion of the effects of the proposed action on listed species in accordance with Section 7 of the Endangered Species Act of 1973 as amended (16 USC 1531 *et seq.*). This biological opinion is also being provided to Portland General Electric as FERC's designated non-Federal representative.

In this biological opinion, NOAA Fisheries has determined that the proposed action is not likely to jeopardize the continued existence of Upper Willamette River chinook, Lower Columbia River chinook, and Lower Columbia River steelhead. A complete administrative record of this consultation is on file with the NOAA Fisheries Hydropower Division in Portland, Oregon.

In addition to the biological opinion, enclosed as Section 3 is a consultation regarding essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). NOAA Fisheries finds that the proposed action will adversely affect EFH for coho and chinook salmon and recommends that the Terms and Conditions of Section 2 of the biological opinion be adopted as EFH conservation measures. Pursuant to MSA (§305(b)(4)(B) and 50 CFR 6000.920(j), Federal agencies are required to provide a written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations.

Comments or questions regarding this biological opinion and MSA consultation can be directed to Keith Kirkendall of the NOAA Fisheries Hydropower Division at 503-230-5431.

Sincerely,

D. Robert Lohn
Regional Administrator

cc: Julie Keil, PGE
FERC Service List

Endangered Species Act
Section 7 Consultation

Biological Opinion

and

Magnuson-Stevens Fishery Conservation and Management Act Consultation

Interim Operation of the North Fork (FERC No. 2195) and Oak Grove (FERC No. 135) Hydroelectric Projects through 2006

Clackamas River
Clackamas County, Oregon

Action Agency:	Federal Energy Regulatory Commission
Consultation Conducted by:	NOAA Fisheries Northwest Region Hydropower Division
NMFS Log Number:	F/NWR/2002/00477
Date:	March 4, 2003

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ACRONYMS AND ABBREVIATIONS

BA	biological assessment
BE	biological evaluation
BO	biological opinion
BRT	Biological Recovery Team
cfs	cubic feet per second
cms	cubic meters per second
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
FPS	Fish Passage Subgroup
ft	foot, feet
ITF	Interagency Task Force
LCR	lower Columbia River
LWD	large woody debris
m	meter
mi	mile, miles
MOA	Memorandum of Agreement
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MW	megawatt
NEPA	National Environmental Policy Act
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
PFC	properly functioning condition
PGE	Portland General Electric
PIT-tag	Passive Integrated Transponder-tag
RM	river mile
RPM	reasonable and prudent measure
the Services	NOAA Fisheries and U.S. Fish and Wildlife Service
USC	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	Upper Willamette River
WLCTRT	Willamette/Lower Columbia Technical Recovery Team

1. INTRODUCTION

The Endangered Species Act (ESA) of 1973 (16 USC 1531-1544), as amended, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NOAA Fisheries), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species. The Clackamas River contains three protected salmonid evolutionarily significant units (ESU): Upper Willamette River (UWR) and Lower Columbia River (LCR) chinook salmon and LCR steelhead. This biological opinion (BO) is the product of an interagency consultation pursuant to Section 7(a)(2) of the ESA and implementing regulations found at 50 CFR §402. The objective of this BO is for NOAA Fisheries to determine whether the Federal Energy Regulatory Commission's (FERC) proposed authorization of the interim operation of Portland General Electric's (PGE) North Fork and Oak Grove hydroelectric projects through 2006 is likely to jeopardize the continued existence of ESA-listed species. The analysis also fulfills requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The administrative record for this consultation is on file with the Hydropower Division, Northwest Region, NOAA Fisheries.

The Federal Energy Regulatory Commission proposes to issue an operating license modification to PGE, a private power generation and distribution corporation, for the operation of the North Fork and Oak Grove hydroelectric projects, located near Estacada, Oregon. Under the proposed license modification, the two projects would be grouped into one, the Clackamas River Hydroelectric Project (the Project). The purpose of this license is to generate and sell electricity. FERC is proposing to issue the license according to its authority under the Federal Power Act (FPA).

1.1 Background and Consultation History

The current FERC licenses for the Oak Grove (License No. 135) and North Fork (License No. 2195) projects expire August 31, 2006. Because relicensing is currently ongoing and a new license will not be issued until 2006 at the earliest, PGE, in coordination with NOAA Fisheries and USFWS (the Services), developed an interim operation Biological Evaluation (BE) consistent with the Interagency Task Force (ITF) draft guidelines. PGE has filed a notice of its intent to seek a new license from FERC. FERC intends to prepare an Environmental Impact Statement in cooperation with the U.S. Forest Service (USFS) to comply with the environmental review requirements of the National Environmental Policy Act (NEPA), the Council on Environmental Quality guidelines implementing NEPA, and the FPA.

PGE, working cooperatively with other parties interested in the Project, chose to pursue an alternative licensing process in accordance with FERC Order No. 596, dated October 29, 1997. In so doing, PGE elected to proceed with a NEPA alternative process for the relicensing of the

Project. PGE filed its request to relicense the Project using the alternative process on September 1, 1998. FERC approved that request on December 10, 1998.

Pre-consultation began in late 1998 with a review by Stillwater Sciences (1999) of the anadromous salmonid issues for PGE's projects in the basin. By July 2000, the Services and PGE began discussions over ways to integrate Section 7 consultation requirements with FPA licensing obligations. This new approach used the ongoing ITF efforts involving NOAA Fisheries, FERC, and other Federal agencies proposals to integrate the statutory and regulatory mandates of both the ESA and FPA.

As a means to address the demanding and complex requirements of both Section 7 and the FPA, the Services, in collaboration with PGE, developed a matrix of Project effects and actions to mitigate those effects. The objective of the matrix was two-fold. The first objective of this conference and consultation process was to ensure that Project operations during the interim period leading up to Project relicensing would avoid jeopardy and minimize and/or avoid take of listed and proposed species. The second objective was to ensure that evaluation and conservation measures conducted in the interim period begin to identify and ameliorate causes of take from Project operations.

On November 27, 2001, PGE applied to FERC for a license amendment that incorporates the proposed Project modifications (runner replacement at Faraday Dam, operational changes at the North Fork Powerhouse, modification of the River Mill Dam spillway, and replacement of the existing River Mill fish ladder) with proposed conservation measures to reduce take of listed, proposed, and candidate salmonids. A BE, which evaluated the effects of interim operations, was included with the license amendment application. The proposed action that is the subject of the consultation is the adoption by FERC of the proposed license amendment and the subsequent operation by PGE of the Project under the terms of the existing license, as amended through 2006, or until such time as a new license for the Project is issued, whichever comes first. FERC included a biological assessment (BA) with its request for consultation. FERC requested NOAA Fisheries' concurrence that the proposed action is not likely to adversely affect LCR chinook salmon and requested formal consultation for two other salmon and steelhead ESUs. FERC requested this consultation with NOAA Fisheries in a letter dated March 26, 2002. FERC believes that the license amendment and the conservation measures included therein can be implemented prior to relicensing of the Project. Longer-term conservation recommendations will be identified and evaluated during the collaborative relicensing process.

After receiving and reviewing a copy of the BA from FERC, the Services and PGE determined that important elements of PGE's BE had been omitted from the BA. The Services and PGE held a series of discussions about the omissions. FERC was then contacted by the Services and PGE about the omissions. In a letter dated July 1, 2002, FERC stated that all proposed actions and conservation measures in PGE's November 27, 2001, BE were incorporated in the BA by reference.

In a letter dated July 16, 2002, NOAA Fisheries acknowledged the receipt of the BA. This letter also initiated informal consultation on LCR chinook. The informal consultation determined that the proposed action was likely to adversely affect LCR chinook, informal consultation was completed, and NOAA Fisheries proposed that formal consultation regarding this ESU be included in the interim BO. Thus, this BO will review and conclude on effects to UWR and LCR chinook and LCR steelhead.

On July 25, 2002, in accordance with the Secretarial Order concerning American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the ESA (June 5, 1997), NOAA Fisheries sent letters to the Confederated Tribes of Siletz, the Confederated Tribes of Warm Springs, and the Confederated Tribes of the Grande Ronde Community of Oregon. The letters notified the previously cited Tribes that NOAA Fisheries was initiating an ESA consultation that may affect Indian lands, tribal trust resources, or the exercise of American Indian tribal rights, and solicited any information, traditional knowledge, or comments the Tribes may wish to provide to help in this consultation.

The USFWS completed its informal consultation on the Project in a letter dated July 31, 2002 (following the announcement that coastal cutthroat trout would not be listed under the ESA). The USFWS concluded that the proposed action would not adversely affect any of the listed species under USFWS jurisdiction.

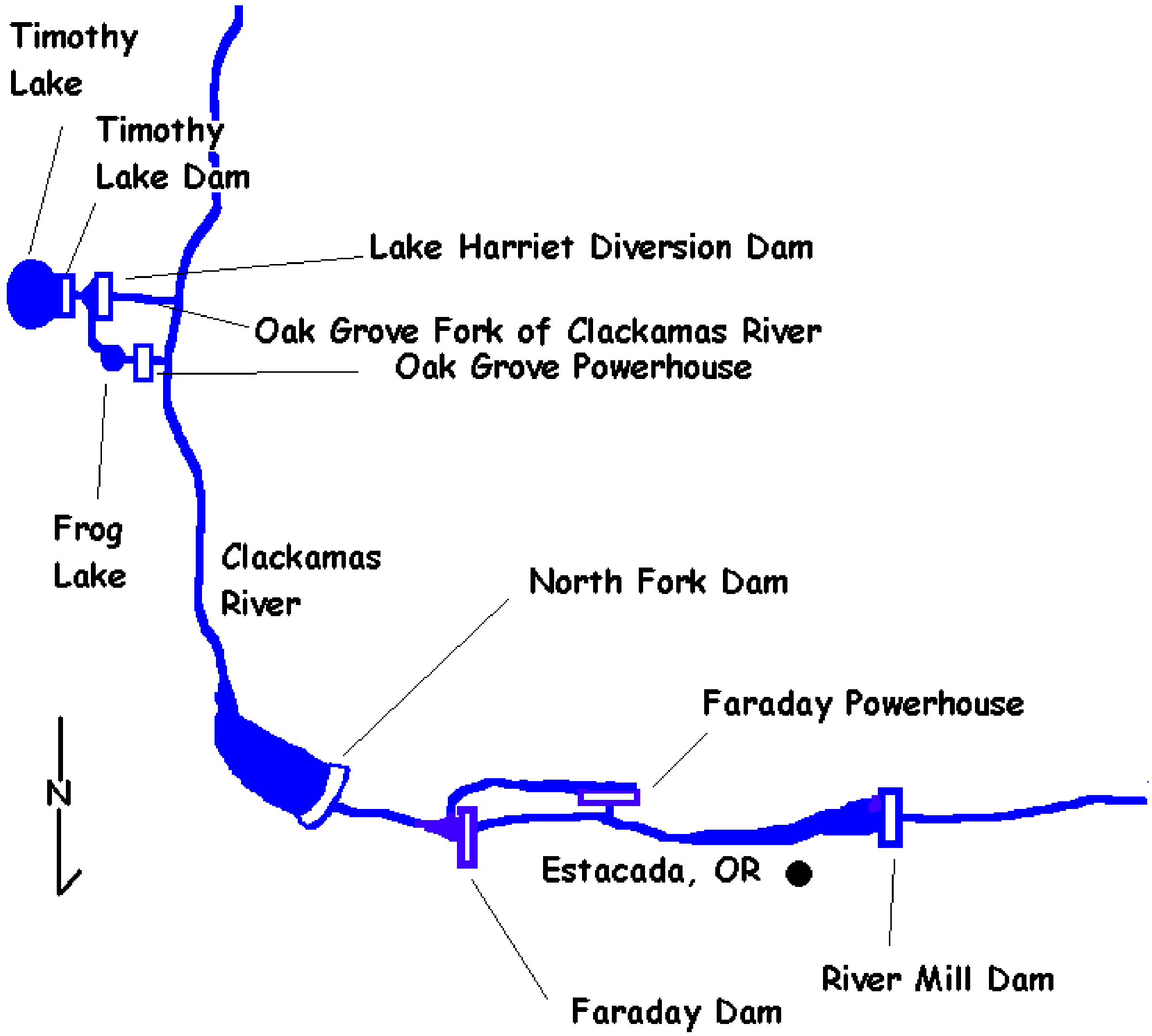
1.2 Description of Proposed Action

The Project is operated by PGE. The Project's licenses were issued by FERC under the FPA and both expire in 2006. PGE is applying to FERC for a license amendment to install a new turbine runner at the Faraday Powerhouse, operate a new runner installed at North Fork Dam, modify the River Mill Dam spillway, and replace the River Mill fish ladder. Accordingly, PGE is the "applicant" for purposes of the ESA Section 7 consultation and conference for the proposed license amendment. PGE is FERC's designated non-Federal representative for preparation of a BA for this consultation. The proposed action considered in this BO is operation of the Project under the current licenses, modifications included in the proposed license amendments described in this section of the BO, and conservation measures described in this section of the BO. The duration of the proposed action is about three years, until the issuance of a new FERC license for the Project.

1.2.1 General Description of the Project

The Project is located on the Clackamas River between Estacada, Oregon, and the south slopes of Mount Hood. The Project includes the North Fork and Oak Grove hydroelectric projects. The North Fork Project, located near Estacada, Oregon, comprises three dams, North Fork, Faraday, and River Mill. The Oak Grove Fork Project, is located on the Oak Grove Fork of the Clackamas River and comprises two dams, Timothy Lake Dam and the Lake Harriet Diversion Dam (Figure 1).

Figure 1. A schematic map of the Oak Grove and North Fork hydroelectric projects.



1.2.1.1 Oak Grove Project

The Timothy Lake Dam impounds Timothy Lake, the only significant storage in the Oak Grove system, a reservoir with a capacity of 61,740 acre-ft. The dam is an earthfill structure with a maximum height of 100 ft. Water is released from the lake through an intake tower just upstream of the dam through a 9-ft diameter concrete tunnel which runs through the base of the dam. There is a Howell-Bunger valve at the exit of the tunnel. Timothy Lake is operated to store spring inflows for release to augment flows to the Oak Grove Powerhouse in the fall and winter when natural flows are insufficient for powerhouse operation. Drawdown typically begins after Labor Day, the reservoir being drawn down 10-12 ft. Rarely, Timothy Lake will be drawn down as far as 15 ft.

Water released from Timothy Lake flows to the Lake Harriet Diversion Dam, a rockfill dam with a concrete arch core and maximum height of 68 ft. The Lake Harriet Diversion Dam diverts water from the Oak Grove Fork channel into a 9-ft diameter pipeline. The pipeline carries flows 4.1 mi to Frog Lake. It is a small off-channel forebay constrained by levies. Frog Lake was constructed in 1954 to provide a forebay to the Oak Grove Powerhouse that would improve water supply to the plant. It was reconstructed and reduced in size in 1997. From Frog Lake, the pipeline continues another 2.3 mi to a surge tank, a penstock, and the Oak Grove Powerhouse. The powerhouse has two Francis-type turbines and generators and has a capacity of 44 MW. The powerhouse discharges the diverted flow into the Clackamas River downstream of the Oak Grove Fork confluence with the Clackamas River near RM 48. Downstream of the Oak Grove Powerhouse, the Clackamas River flows through an unmodified channel until reaching the upper end of the North Fork Reservoir.

Access to the Oak Grove Fork by anadromous fish is blocked by a 20-ft (6.1-m) natural waterfall 1 mile downstream of Lake Harriet Diversion Dam. Lake Harriet and Timothy Lake dams, therefore, do not block adult upstream passage of anadromous salmonids, and these dams are not fitted with adult upstream passage facilities. These dams also do not include downstream migrant facilities.

1.2.1.2 North Fork Project

The facilities comprising the North Fork Hydroelectric Project are located between RM 33.5 and RM 23. The North Fork Project is located on the mainstem Clackamas River and consists of three developments:

- North Fork Dam and Powerhouse (RM 30)
- Faraday Diversion Dam and Powerhouse (RM 26.2)
- River Mill Dam and Powerhouse (RM 23)

North Fork Dam has a maximum height of 206 ft (62.8 m) and impounds North Fork Reservoir, which is about 3.5 mi (5.6 km) long and 0.25 mi (0.4 km) wide. Intake gates located on the dam's upstream face direct flow to penstocks that lead to the powerhouse turbines at the foot of the dam. After passing through the North Fork Powerhouse's two Francis-type turbines, flow is returned to the Clackamas River and continues downstream to Faraday Diversion Dam. The capacity of the North Fork Powerhouse is 54 MW.

Faraday Diversion Dam is a low concrete structure that diverts flow to an off-channel forebay to the Faraday Powerhouse. Just upstream of the dam, a gated intake diverts flow into a 23-ft (7-m) diameter tunnel leading to an unlined canal and then to the powerhouse forebay. The forebay is formed at the base of a hillside by a 1,500-ft (457-m) long earthfill embankment and a 1,200-ft (366-m) long concrete dam. Faraday Powerhouse is located 1.7 mi (2.7 km) downstream of the diversion dam. It is equipped with five double-runner horizontal Francis-type turbines and one newer vertical Francis-type turbine and has a generating capacity of 43 MW. After passing through the powerhouse, flow is returned to the Clackamas River and continues downstream to River Mill Dam.

River Mill Dam has a maximum height of 85 ft (26 m) and forms Estacada Lake, which extends about 2.9 mi (4.7 km) upstream. Intake gates to the powerhouse are located on a sloping face behind trashracks on the upstream face of the powerhouse. These gates lead to 11-ft (3.4-m) diameter penstocks that supply five Francis-type turbine-generator units in the River Mill Powerhouse. Total generating capacity of the River Mill Powerhouse is 19 MW. Water released from the River Mill Powerhouse is discharged back into the Clackamas River.

Facilities for the passage of upstream migrating salmonids are currently provided at all of the dams within the North Fork Project. Upstream passage is provided by two fish ladders: (1) the River Mill fish ladder, which provides passage over River Mill Dam into Estacada Lake; and (2) the Faraday-North Fork fish ladder, which spans 1.7 mi (2.7 km) and provides passage over both Faraday Diversion Dam and North Fork Dam. Facilities for the passage of downstream migrating juveniles are provided at the North Fork and River Mill dams, but not at the Faraday Diversion Dam or the Faraday Powerhouse. The juvenile bypass facility at the North Fork Dam consists of a surface collection system, the Faraday-North Fork fish ladder, a separator, an evaluation station, and a bypass pipeline. Juvenile salmonids migrating downstream from the upper Clackamas River are attracted to a surface collection facility in North Fork Reservoir and are passed into the Faraday-North Fork fish ladder. Near the lower end of the 1.7-mi (2.7 km) long fish ladder, the downstream migrants pass through a "separator," where they are screened out, passed through a passive integrated transponder (PIT)-tag detector, and then diverted into a downstream pipeline. The separator also collects a subsample of fish into a holding box where they are counted, passed through a PIT-tag detector, and measured before being released into the downstream pipeline. The juveniles then travel about 5 mi (8 km) through the pipeline and are returned to the river at the tailrace downstream of River Mill Dam. The outlet of this pipeline is about 20 ft (6.1 m) above the water surface of the river. The North Fork Dam spillway is also partially screened to protect juvenile downstream migrants. Spilled flows up to 500 cfs pass through a screen that diverts juveniles to the juvenile bypass facility. Spilled flows exceeding

500 cfs are not screened. For example, if 1,000 cfs is spilling, 500 cfs is screened and 500 cfs is unscreened.

1.2.2 Maintenance and Ongoing Operations

The facilities of the Oak Grove Project are operated within certain constraints. In modeling the operations of the Clackamas River Hydroelectric Project, Gomez and Sullivan Engineers (2001) reviewed available U.S. Geological Survey (USGS) gage data and extensive information on the performance of the facilities to determine the general set of constraints described below. Operations described here are typical operations, adopted for modeling purposes, and do not represent license constraints.

1.2.2.1 Timothy Lake

Operational criteria for Timothy Lake are as follows:

- Timothy Lake is typically maintained at elevation 3,190 ft from Memorial Day to Labor Day.
- A minimum flow of 10 cfs is released year round.
- The maximum discharge below Timothy Lake is 300 cfs plus inflow into the reservoir.
- Timothy Lake is operated to minimize spillage at Harriet Lake. The maximum rate of change in river stage in the Oak Grove Fork below Timothy Lake Dam is 0.33 ft per hour.

1.2.2.2 Lake Harriet

Operational criteria for Lake Harriet are as follows:

- Lake Harriet is maintained near flashboard crest elevation to maximize the flow in the penstock from Lake Harriet to Frog Lake. Three-ft-high flashboards (crest 2,038 ft) are currently maintained at Lake Harriet.
- The maximum head drop between Lake Harriet when full (2,038 ft) and Frog Lake when at its lowest operating elevation (1,978 ft) is 60 ft.
- The maximum flow that can be passed through the penstock, taking into account penstock friction losses, was computed by Gomez and Sullivan Engineers (2001) as 552 cfs. Based on more recent studies, it appears that the diversion capacity from Lake Harriet to Frog Lake has increased to about 660 cfs. The increase in flow is a function of recoating the upper portion of the penstock from Lake Harriet to Frog Lake (thus decreasing penstock friction). PGE has indicated that this recoating has resulted in higher flow conveyance in the penstock. The diversion capacity of 660 cfs was determined based on correlating flows at the Lake Harriet gage with flows measured in the Harriet bypass during the period 1994–1995 (PGE 2001b). Any inflow to Lake Harriet exceeding the penstock capacity is spilled to the Oak Grove Fork.

1.2.2.3 Frog Lake and Oak Grove Powerhouse

Operational criteria for Frog Lake and the Oak Grove Powerhouse are as follows:

- Frog Lake is drawn down and refilled each day. The drawdown typically occurs between 6:00 a.m. and 8:00 a.m., and the reservoir remains drawn down until around 10:00 p.m. During the drawdown cycle, Frog Lake inflow is less than the Oak Grove turbine discharge, which causes the drawdown. Around 10:00 p.m., turbine discharge in the Oak Grove Powerhouse is decreased to a level less than Frog Lake inflow, causing Frog Lake to refill. The Frog Lake fluctuation over each day's drawdown/refill cycle is about 14 ft.
- The Oak Grove Powerhouse is operated for peaking.
- The maximum capacity of the pipeline from Frog Lake to the Oak Grove Powerhouse is 650 cfs.
- There are no ramping rate restrictions on the Oak Grove Powerhouse, and discharge typically fluctuates by 288 cfs/day.
- During high flow periods, PGE generally operates the Oak Grove Powerhouse at 42 MW (full capacity) for part of the day, and then reduces generation to 30 MW to refill Frog Lake during off-peak hours. During low flow periods, generation ranges between 21 MW and 42 MW during peak hours and is 12 MW during off-peak hours.

As with the Oak Grove Project, the facilities of the North Fork Project are operated within certain constraints. In modeling the operations of the Clackamas River Hydroelectric Project, Gomez and Sullivan Engineers (2001) reviewed available USGS gage data and extensive information on the performance of the facilities to determine the general set of constraints described below. Operations described here are typical operations, adopted for modeling purposes, and do not represent license constraints.

1.2.2.4 North Fork Reservoir and Powerhouse

Operational criteria for North Fork Reservoir and the North Fork Powerhouse are as follows:

- North Fork Reservoir generally operates between elevation 665 and 663 ft throughout the year, although there are some instances when the reservoir falls below 663 ft. On an average daily basis, the reservoir fluctuates roughly 0.2 ft. There are periods during which the reservoir is maintained at a stable elevation (i.e., there is no daily fluctuation).
- Flow through the Faraday-North Fork fish ladder is maintained at 40 cfs.
- During high flow periods, peak generation is about 42 MW and off-peak generation is 32 MW. During lower flow periods, North Fork Dam is operated in close to a run-of-the-river mode, and generation ranges between 8-23 MW.
- The maximum hydraulic capacity at the powerhouse 5,360 cfs.

1.2.2.5 Faraday Diversion Dam and Powerhouse

Operational criteria for the Faraday Diversion Dam and Powerhouse are as follows:

- The hydraulic capacity of the North Fork turbines exceeds the hydraulic capacity of the Faraday turbines. In reviewing available data, Gomez and Sullivan Engineers (2001) determined that the elevation does not fluctuate; therefore, they modeled the forebay at a constant elevation of 521 ft. (The powerhouse is operated as a run-of-the-river facility.)
- A 1956 Memorandum of Agreement (MOA) among PGE, the Oregon Fish Commission, and the Oregon Game Commission (now ODFW) set instream flows in the bypass reach between the Faraday Diversion Dam and the Faraday Powerhouse ranging from 55-90 cfs. The MOA also includes specific requirements for operating flows (43 cfs) and attraction flows (80 cfs during spill) for the Faraday-North Fork fish ladder. PGE maintains flows greater than 100 cfs in the bypass reach year-round, exceeding the flow requirements identified in the MOA.
- The maximum hydraulic capacity at the Faraday Powerhouse is 5,030 cfs.

1.2.2.6 River Mill Reservoir, Dam, and Powerhouse

Operational criteria for the River Mill Development are as follows:

- The level of Estacada Lake, the River Mill reservoir, does not generally fluctuate and is managed at an elevation of 388.9 ft from July through September 30. During the remainder of the year, the reservoir is managed at an elevation of 387.9 ft.
- River Mill Dam is operated as a run-of-the-river facility.
- The minimum flow downstream of River Mill needed to adequately supply the pumps at the Clackamas River Fish Hatchery, located about 0.5 mi downstream of the dam, and to meet the requirements of public water supply systems downstream from the hatchery is 300 cfs.
- Flows in the River Mill fish ladder are maintained at 40 cfs throughout the year.
- The River Mill Powerhouse operates continuously, with generation outflows approximating inflows to Estacada Lake. Powerhouse generation capacity at the River Mill Powerhouse is 23 MW. The maximum hydraulic capacity at the River Mill Powerhouse is 4,400 cfs.

1.2.3 Proposed Modifications to Project Operations and Structures

FERC proposes to amend the Project licenses to (1) permit the installation and operation of a replacement runner at the Faraday Powerhouse Unit 6; (2) change Project operations at North Fork Dam and Powerhouse to take advantage of the increased capacity of Unit 2, the runner that was replaced in 2001 (but has not been operated at the increased capacity); (3) modify the spillway of River Mill Dam to improve downstream passage of juvenile salmonids; and (4) replace the adult fish ladder at the River Mill Dam with a new ladder.

1.2.3.1 Proposed Modifications to Existing Structures

1.2.3.1.1 Faraday Unit 6 Runner Replacement

The Faraday Powerhouse was completed in 1907 and has since undergone several repairs and upgrades. The powerhouse includes six generation units. The current units 1 through 5 were last reconstructed in 1953–1954 and repaired in 1972. Unit 6 was added in 1956 and consists of a 34,500-hp turbine generator unit with a rated capacity of 25 MW. The current capacity of the entire Faraday Powerhouse is 44 MW.

The proposed action replaces the existing Unit 6 turbine runner with a new runner of modern design. The objective of this runner replacement is to increase turbine hydraulic efficiency and maximum output capacity of Faraday Powerhouse Unit 6. With the increase in hydraulic efficiency, more power can be generated from the flow available under the State water right, and the average annual energy production will be increased. The new runner will be constructed with stainless steel blades, stainless steel band, and a carbon steel crown. Some existing turbine component refurbishment work will also be completed during the runner replacement outage. Generator work will consist of inspections, stator rewedging, and coil tightening as needed.

The existing runner is a Francis-type runner with 16 carbon steel buckets. The replacement runner will be Francis-type with 17 stainless steel buckets. The runner replacement work would involve machinery modifications and construction activity at the Faraday Powerhouse over a period of about 5 months in 2002. For the replacement, the turbine will be shut down and then isolated from the upstream water by closing the turbine shutoff valve. The turbine's draft tube gate will also be closed to isolate the turbine from the powerhouse tailwater. Major steps in the replacement will include disassembly of the unit's generator and turbine components, rewinding the generator, installation of the new turbine parts, reassembly of the turbine-generator, and then testing of the modified unit. Essentially all of the work will be completed within the powerhouse building. During the work on Unit 6, the remaining five units will operate normally. Critically low flows will require final acceptance testing of the unit to be done during the spring of 2003.

1.2.3.1.2 Modification of the River Mill Dam Spillway

The River Mill Dam was originally constructed in 1910–1911 and consists of a spillway dam and powerhouse between rock abutments. Both the spillway dam and powerhouse/intake section are Ambursen buttress type. The spillway dam is 405-ft (123.5 m) long, and the powerhouse intake is 173-ft (52.7 m) long. A 54-ft (16.5-m) long non-overflow section separates the powerhouse from the spillway. The maximum height of the dam is about 85 ft.

Since its original construction, the spillway has been modified several times. In 1939, the Ambursen-type dam was "refaced" with an additional layer of concrete. In 1966–1967, the spillway capacity was increased by 50% (to 150,000 cfs) to match that of the North Fork Dam spillway. Because new flood calculations required additional spillway capacity, abutments and wing walls were topped with 8 ft of concrete, and a compacted-earth dike was built across the lowlands at the south end of the dam. In 1985, four sluiceways in the spillway dam were permanently sealed with concrete plugs; the steel gates in the sluiceways are now inoperable. In 1996, Obermeyer gates were added to a 60-ft section of the spillway nearest to the powerhouse to improve regulation of downstream flow. These gates are raised and lowered by an inflatable rubber bladder. No other gates are present at the dam. The remainder of the spillway section is topped by flashboards up to 3 ft in height, which are installed seasonally to increase storage. The proposed action will modify the spillway to improve downstream passage of juvenile salmonids. In its current configuration, the spillway is steep and terminates on a rough bedrock outcrop in the river. Injury and mortality of juvenile salmonids passing over this spillway has been observed by PGE biologists. An evaluation of spill management options using the improved spillway at the River Mill Dam will be completed during relicensing; this evaluation will include determining what spill volume and what duration of spill causes fish migration at River Mill Dam. Spill enhancements will be designed as part of the overall approach to improving juvenile fish passage at the Project.

PGE engineers and fish biologists have examined potential modifications to the spillway at River Mill Dam to improve downstream fish passage conditions and reduce fish mortality. PGE's initial concept involves a new concrete channel on the face of the dam and a concrete apron across the exposed rock below the spillway. This design will allow PGE to periodically lower the spillway gate during downstream fish migration to pass salmonids over the dam. PGE's consultants have evaluated several spillway modification alternatives. Their recommended alternative, proposed in the BA, is to split the spillway gate and use a 7.5-ft-wide straight channel (Duke Engineering & Services 1999). The recommended spillway alternative is described in detail in the BE (PGE 2001b). This alternative would allow 150 cfs to be released by operating the gate fully opened and would reduce fish impact on the concrete spillway. In addition to the modification of the spillway channel, the proposed action includes constructing a smooth concrete apron over the bedrock sill at the base of the dam to improve fish passage during higher flow conditions (i.e., spills exceeding 150 cfs).

Prior to implementation of the spillway modification, PGE will provide the final construction specifications and a detailed description of construction implementation to NOAA Fisheries for its review, comment, and approval. The specific implementation plan will be provided to the NOAA Fisheries at least 90 days prior to commencement of construction. As noted in the BE, construction on spillway modifications will begin in 2003 (PGE 2001b).

1.2.3.1.3 Construction of a New River Mill Fish Ladder and Spillway Modification

The Fish Passage Subgroup (FPS) of the relicensing collaborative has identified the existing fish ladder at River Mill as inadequate. The FPS concluded that the design parameters used for the construction of the existing ladder were outdated and that there was no practical or cost-effective means to modify the ladder to meet current standards to allow more efficient fish passage.

FERC proposes to require PGE to undertake the design of a new River Mill Dam fish ladder immediately, with construction starting in 2003.

The new ladder will include a sorting facility and the ability to use a truck-and-haul facility to increase management options for both hatchery and wild fish. Various designs for the fish ladder have been reviewed by the FPS, and the preferred conceptual design has been identified in Figures 2 and 3 in the BE. The design criteria for the fish ladder have been identified in the BE, which includes a proposed schedule (PGE 2001b). The final ladder design will meet passage criteria identified by NOAA Fisheries. Implementation of ladder construction will be coordinated with the FPS to ensure that the impacts to listed and proposed species are minimized.

The construction of a new fish ladder will require modification of the Faraday-North Fork downstream migrant outfall. Outfall modifications will be implemented in conjunction with the ladder replacement and will be built to meet existing Services' criteria.

PGE and the Oregon Department of Fish and Wildlife (ODFW) will develop a management plan for operation of the new River Mill fish ladder and trap. A draft of the plan will be completed before operations begin. The Services will be provided an opportunity to approve the management plan. For the purposes of this consultation, NOAA Fisheries assumes that the future fish ladder operational plan will, at a minimum, provide the same protection for listed salmon and steelhead as the current ladder operation plan. Operation of the trap is currently covered by a 4(d) research permit and is not the subject of this consultation. Within two years of construction, PGE will work with the agencies to monitor and evaluate the River Mill fish ladder to assure that operations are consistent with design standards, and biological performance is optimized.

The ladder design and a construction and implementation plan will be submitted to NOAA Fisheries for its review and approval at least 90 days prior to the construction start date. The construction and implementation plan will include standard best-management practices (such as erosion control and in-water work windows) and other necessary measures to minimize impacts to listed and proposed species. Construction of new fish ladder modifications to the River Mill fish ladder, spillway and bypass exit pipe will be conducted in three phases starting in 2003:

> Phase I performs excavation and stabilization at the right riverbank in preparation for fish ladder construction. This phase will also relocate the downstream fish pipe, relocate utilities, and construct temporary access roadways, as needed.
>
> Phase II will construct a major portion of the fish ladder, provide the new concrete apron across the exposed rock below the spillway, and construct the downstream fish passage channel at the spillway. This phase may also modify provisions for fish ladder attraction water. Operation of the existing fish ladder will not be interrupted during phases I and II.

Phase III will construct the remaining lower ladder and the ladder entrances. If needed, the fish guidance structure across the tailrace will also be constructed at this time. The need for this structure will be determined through the ongoing physical modeling efforts. Installation of temporary cofferdams, dewatering of the construction area, removal of existing ladder facilities, and rock excavation will be performed. During the period when neither fish ladder is in operation, provisions for trapping and hauling of upstream migrant fish will be provided as necessary.

The erosion and sedimentation control measures will meet the requirements from the *Erosion Prevention and Sedimentation Control Plans Technical Guidance Handbook,* produced by the Clackamas County Department of Utilities, dated August 1994. All products for erosion and sedimentation control will conform to the guidance handbook.

Excavation will be performed in a manner that prevents soil or significant rock from entering the river. Minor amounts of clean rock rubble from the excavation at the steep right bank or from smoothing of the rock area below the spillway may be allowed to remain in the riverbed. All excess materials from the excavations will either be properly placed on adjacent PGE property above the high-water line or will be hauled to an approved off-site waste area. Any waste areas will be provided to meet the *Clackamas County Excavation and Grading Ordinance.*

Special access to the lower fish ladder construction area may be needed in order to allow timely completion of the new ladder entrances. These provisions may include floating work platforms in the river, a temporary construction road on the north bank, and possibly a floating roadway across the tailrace. All in-water work and work windows will conform to the conditions specified in appropriate permits, including, but not limited to, the 404 permit.

Between the time that the existing ladder is removed from service and the time that the new ladder is determined to be functional, PGE will provide, operate, and maintain a temporary facility to provide upstream migrant passage of adult fish as necessary.

Fish ladder construction will be performed in the dry. Cofferdams will be designed and constructed to have minimum impact on the river. Wastewater from Project activities and dewatering will be routed to an area outside the normal high-water line to allow settling of fine sediments and other contaminants prior to being discharged back to the river.

Demolition of the existing fish ladder facilities will be performed after the temporary fish trap and transport system is functional. Disposal material will be transported to approved off-site disposal sites. Construction over and near the river will be performed in a manner that will minimize the chance that petroleum products, chemicals, or other deleterious materials may enter the water. Temporary spill containment features will be provided at locations where there is a significant risk of a spill.

Disturbance of the riverbed and banks will be kept to a minimum. In-water construction of the fish ladder will be limited to that needed to provide access to the work areas and to properly install, seal, and remove cofferdams. Concrete placement will be performed to ensure that the active flowing stream does not come in contact with fresh, uncured concrete. Any fish stranded in the construction area will be safely moved to the flowing river.

All areas disturbed by construction, including excavated areas, filled areas, temporary access roads, temporary retention ponds and waste areas, shall be graded and restored. Permanent control measures will be maintained as necessary to ensure their continued effectiveness until soil becomes stabilized.

1.2.3.2 Operational Changes

1.2.3.2.1 Operational Changes Resulting from Faraday Unit 6 Turbine Upgrade

Discharge through the runner is governed by a State water right, and no operational change in hydraulic capacity at the Faraday Powerhouse is proposed at this time. The Faraday Powerhouse operates under a pre-1909 water right and a State license issued by the Hydroelectric Commission of Oregon. The pre-1909 water right is for 2,370 cfs (67.1 cms), which can be run through units 1 through 5 of the powerhouse. Unit 6 operates under a separate State license (number 203), which was issued in 1956 and provides a water right for 2,650 cfs (75.0 cms) to be run through the unit. The runner replacement will increase the hydraulic capacity of Unit 6 from its current 2,680 cfs (75.8 cms) to 3,334 cfs (94.4 cms). Maximum flow through the unit, however, would remain limited to 2,650 cfs (75.0 cms) by the State license. The increased efficiency of the new runner will allow more power to be generated per unit flow, thus increasing power generation capacity within the existing State water right. Replacement of the runner, therefore, will not result in increased discharge through the unit, and no changes in operation are anticipated or included in this proposed action.

1.2.3.2.2 Modified Operation of North Fork Powerhouse Unit 2 after Turbine Upgrade

In the summer of 2001, the runner in Unit 2 was replaced with a runner of modern design. The specifications for the old and the replacement runners are the same as for the Faraday Unit 6. The proposed action includes a proposal to modify the operation of the North Fork Dam and Powerhouse to take advantage of the increased power generation efficiency and capacity of the upgraded runner. Installation of the upgraded runner increased the hydraulic capacity of Unit 2 from 2,680 cfs (75.8 cms) to 3,334 cfs (94.4 cms) and increased the total capacity of the powerhouse from 5,360 cfs (151.2 cms) to 6,014 cfs (170.2 cms). Under the proposed action, discharge through Unit 2 will be increased, but total flow through both units of the powerhouse will remain unchanged pursuant to the State license for this powerhouse. The North Fork Powerhouse operates under State license number 202, which was issued in 1956 and provides a water right for 5,400 cfs (152.8 cms). Total discharge through the powerhouse, therefore, will not change.

1.2.3.2.3 Operational Changes Resulting from North Fork Unit 2 Turbine Upgrade

At unit loads below about 20 MW, the upgraded Unit 2 will perform nearly as efficiently as Unit 1, which is not being upgraded. At loads above 20 MW, the upgraded Unit 2 becomes significantly better than Unit 1. For this reason, operation at the North Fork Powerhouse will change somewhat from the past, when the units had identical efficiency characteristics and were operated equally and interchangeably. When the upgraded Unit 2 turbine is operating above about 27 MW, the flows into and through the unit will be higher than in the past. This means the water currents near the intake will also be higher than they were before upgrade of the unit.

After the Unit 2 upgrade:

As in the past, Unit 1 and Unit 2 will be used interchangeably at plant loads below 20 MW. These flows will occur about 45% of the year. As plant loads increase above 20 MW, Unit 2 will be used exclusively until 30 MW is reached. The plant typically operates in the 20 MW to 30 MW load range for about 22% of the year.

At plant loads between 30 MW and 40 MW, both units will be required. The total load will be split fairly equally between the units, similar to past practices. The plant typically operates between 30 MW and 40 MW for about 13% of the year

At plant loads greater than 40 MW, but less than the maximum plant load of about 54 MW, Unit 2 will operate at outputs somewhat higher than Unit 1. The plant typically operates between 40 MW and 54 MW for about 10% of the year.

At maximum plant load of 54 MW, Unit 2 will be operating at about 30 MW and Unit 1 will be operating at about 24 MW. The plant operates at maximum load about 10% of the year, including occasions when the flows at North Fork Dam exceed the capacity of the units and the development is forced to spill. During the maximum plant load situation, more water will be flowing through Unit 2 and less water through Unit 1 than in the past.

1.2.3.3 Fisheries Enhancement Plan or Conservation Plans

Because the proposed actions and continued operation of the Project under the license, with proposed amendments discussed above, have the potential to affect listed and proposed species, PGE has developed a set of measures to provide for the conservation of these species during the time period leading up to FERC relicensing of the Project. These additional measures are set forth in PGE's BE and incorporated by reference into FERC's BA. PGE is working with the Clackamas River Fish and Aquatics Workgroup and Terrestrial Resources Workgroup to identify, design, and implement studies to quantify the effects of operation of the Project on aquatic and terrestrial resources, including protected salmonids. Based on these and previous studies, several reasonable and prudent measures (RPM) have been identified to minimize take and provide immediate benefits to protected salmonids. Additional conservation measures have been identified that will provide information needed for developing longer-term measures during the relicensing process. The proposed conservation measures are described below.

1.2.3.3.1 Implement a Gravel Augmentation Pilot Project Downstream of River Mill Dam

Habitat availability and quality for salmon spawning and rearing downstream of River Mill Dam is being evaluated by the Clackamas Fish and Aquatics Workgroup. One of the hypotheses being tested is that by intercepting the supply of coarse sediment from the upper watershed, the Project has reduced the area and suitability of spawning habitat available downstream of River Mill Dam. Such effects are commonly observed downstream of large dams, and gravel augmentation projects are being implemented on several rivers to mitigate these effects (e.g., the Sacramento and Tuolumne rivers and Clear Creek in California). Of the listed species considered in the BE, this reduction in spawning habitat would primarily affect winter steelhead, which spawn both upstream and downstream of the Project, and fall chinook salmon, which spawn exclusively downstream of the Project. Under this measure, PGE will design, implement, and monitor the introduction of spawning-sized gravel below the River Mill Dam.

PGE will develop, in coordination with geomorphologists and fisheries biologists working in the relicensing process, the study design for the proposed gravel augmentation pilot project. PGE will provide the study design to the Fish and Aquatics Workgroup for its review and comment, with final approval by NOAA Fisheries. Gravel augmentation events will minimize or avoid the use of machinery in the channel. All in-water work conditions and windows will be conformed to as specified in appropriate permits. A fisheries biologist will be on-site during the placement of the gravel to minimize any disturbance to salmonids from this activity. When possible, pre-washed gravel will be used to reduce the introduction of fine sediment into the river. During the winter of 2002, test patches of gravel were placed to determine dispersal patterns from high flow events. This will provide guidance for the selection of test sites. The study design will be approved during 2003 so that gravel can be introduced into the river in the fall of 2003. NOAA Fisheries will be updated in 2004 on the movement of the introduced gravel and any observed utilization by spawning winter steelhead and fall chinook.

1.2.3.3.2 Manage Spills in the North Fork Project to Reduce Entrainment in Faraday Powerhouse

Previous studies have indicated that large numbers of downstream juvenile salmonid migrants may pass over the North Fork Dam spillway during spills. These fish are then subject to entrainment in the Faraday Powerhouse and the River Mill Powerhouse. To reduce entrainment risk to these fish during peak downstream migration periods, PGE will reduce generation at the

Faraday Powerhouse to ensure that at least 50% of the flow at the Faraday Diversion Dam is spilled following spill at North Fork Dam during April–June and October–November.

The duration of spill at the Faraday Diversion Dam will be as follows:

- For spills at North Fork Dam that are less than 12 hours in duration and less than 2,000 cfs (56.6 cms) in magnitude, 50% of the flow at the Faraday Diversion Dam will be spilled for a period of 24 hours.
- For spills at North Fork Dam that exceed 12 hours in duration and/or exceed 2,000 cfs (56.6 cms) in magnitude, 50% of the flow at the Faraday Diversion Dam will be spilled for a period of 48 hours.
- For spills at North Fork Dam that exceed 12 hours in duration and/or 2000 cfs (56.6 cms) in magnitude, at least 400 cfs will be spilled at River Mill Dam for up to 48 hours following the end of spill at North Fork Dam.

1.2.3.3.3 Provide Increased Operating Flows Downstream of River Mill Dam

The North Fork Project (including the North Fork, Faraday, and River Mill developments) affects instream flows in the mainstem Clackamas River from the River Mill Dam to the confluence with the Willamette River. Exhibit H-2 of the current FERC license for the North Fork Project states that the flows downstream of River Mill Dam are not to be reduced below 300 cfs (8.5 cms). PGE has adopted voluntary flow guidelines including minimum operating flows that are implemented on a best-efforts basis (Table 9.1 of the BE, reproduced here as Table 1) (PGE 2001b). These guidelines provide minimum operating flows of 1,000 cfs (28.3 cms) from November 1 through April 30, 1,400 cfs from May 1 through July 15, and 600 cfs (17.0 cms) from July 16 through September 30. FERC will modify the license to require PGE to operate the North Fork Project to provide the flows shown in Table 1 and will codify these current voluntary guidelines as a conservation measure to be implemented under the amended license. Flow needs downstream of River Mill Dam will be quantitatively evaluated during relicensing.

Table 1. Operating flows downstream of River Mill Dam.

Period	**Minimum Restrictions**	**Maximum Restrictions** **Natural flow (inflow)**	**Maximum allowable increase in flow at dam**
November –February	Discharge can be reduced below natural flow between 8 p.m. to 2 a.m. Do not go below 1,000 cfs. If necessary to reduce on other hours, minimum flow is 1,400 cfs.	1,200 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs	+ 1,000 cfs up to 4,200 cfs (total flow) up to 5,300 cfs (total flow)
March – April	Discharge can be reduced below natural flow between 9 a.m. to 1 a.m. Do not go below 1,000 cfs. If necessary to reduce on other hours, minimum flow is 1,400 cfs.	1,200 cfs to 2,199 cfs — 2,200 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs —	+ 800 cfs + 1,000 cfs up to 4,200 cfs (total flow) up to 5,300 cfs (total flow)
May	Discharge can be reduced below natural flow between 10 p.m. and midnight only. Do not go below 1,400 cfs.	1,200 cfs to 2,199 cfs — 2,200 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs —	+ 800 cfs + 1,000 cfs up to 4,200 cfs (total flow) up to 5,300 cfs (total flow)
June – July 15	Do not reduce below natural flow or 1,400 cfs, whichever is less.	800 cfs to 1,199 cfs — 1,200 cfs to 2,199 cfs — 2,200 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs —	+ 600 cfs + 800 cfs + 1,000 cfs + 1,400 cfs up to 5,300 cfs (total flow)
July 16 – August 31	Discharge can be reduced below natural flow between 10 p.m. and 3 a.m. Do not go below 600 cfs. If necessary to reduce on other hours, minimum 1,000 cfs.	600 cfs to 999 cfs — 1,000 cfs to 1,799 cfs — 1,800 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs —	+ 600 cfs + 800 cfs + 1,000 cfs + 1,400 cfs up to 5,300 cfs (total flow)
September	Discharge can be reduced below natural flow between 10 p.m. and 2 a.m. Do not go below 600 cfs.	600 cfs to 999 cfs — 1,000 cfs to 1,999 cfs — 2,000 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs —	+ 600 cfs + 800 cfs + 1,000 cfs up to 4,200 cfs (total flow) up to 5,300 cfs (total flow)
October	Discharge can be reduced below natural flow between 8 p.m. to 2 a.m. Do not go below 800 cfs.	600 cfs to 1,199 cfs — 1,200 cfs to 2,699 cfs — 2,700 cfs to 3,500 cfs — > 3,500 cfs —	+ 800 cfs + 1,000 cfs up to 4,200 cfs (total flow) up to 5,300 cfs (total flow)

1.2.3.3.4 Acquire Important Spawning and Rearing Habitat for Salmon and Steelhead in the Clackamas River Basin

NOAA Fisheries (NMFS 1995, 1996, 1998) found habitat degradation and impaired access to spawning habitat to be contributing factors in the decline of the LCR steelhead, chinook, and coho, respectively. FERC will require PGE to invest $3 million in land and water acquisitions along the mainstem Clackamas River or tributaries to the Clackamas River that are considered to be important for salmon and steelhead spawning and rearing. PGE will target for acquisition sites that are under risk of development or timber harvest. Areas that will be considered may be located downstream of River Mill Dam or upstream of North Fork Reservoir, including private holdings within the Mt. Hood National Forest.

Federal agencies, State agencies, and non-governmental organizations (NGO) will be consulted in the selection of the lands and water to be acquired. PGE may partner with other entities seeking to acquire land and water for habitat protection. Investigation of methods to restore riparian vegetation and geomorphic processes will be undertaken immediately after acquisition, with appropriate actions implemented on a schedule developed in consultation with the parties participating in the land and water acquisition selection process. The final title to the acquired sites may reside with PGE, may be transferred to a State or Federal land manager, or may be transferred to a trust, such as The Nature Conservancy, as warranted. PGE will be expending about $1 million in each year from 2002 through 2004 towards this effort. PGE invested $2 million in 2002 to purchase approximately 375 acres of riparian reaches along Eagle Creek and the North Fork Eagle Creek. This timbered land was purchased from Longview Fibre Company and is contiguous with U.S. Bureau of Land Management properties in the basin. PGE will invest an additional $1.5 million in similar properties during 2003.

Lands acquired in this conservation measure may or may not be actively restored. Much of the value of this habitat acquisition is the removal of a development threat. With the threat removed, passive restoration may be sufficient. On some acquisitions, watershed function could benefit from restoration activities. This could include, but is not limited to, reconnection of the floodplain, tree plantings, and invasive weed removal. All in-water activities performed for this restoration will conform to the in-water work window. The Services will be provided the opportunity to review the restoration plan and concur in writing prior to its implementation.

Another important habitat feature for salmonids that will be protected by this conservation measure is streamflow. ODFW found that the loss of streamflow to consumptive uses is one of the key factors in the decline of anadromous fish resources in Oregon. ODFW has established the priorities for streamflow restoration throughout Oregon. Priorities are based on individual rankings of several biological and physical factors: the number of native anadromous species, ecological benefits for fish species, physical habitat conditions, the extent of human influence, water quality, the presence of instream flow protection, and natural low flow problems. PGE will work with ODFW in selecting water conservation projects.

The evaluation of potential projects and acquisitions will be undertaken in conjunction with the steering group established by the Enron/PGE merger Memorandum of Understanding. PGE may choose to have the process of evaluating and selecting projects managed by the River Conservancy or other equivalent group. Guidelines for selecting acquisition sites are:

- Physical connection or proximity to the Project.
- Protection of spawning or rearing habitat for listed salmonids.
- Threat of development or habitat alteration.
- Length of protection (PGE's goal is protection for no less than the term of the new license).
- Consistency with agency priorities/management plans.
- Improvement of instream flows/geomorphic processes.
- Opportunity to reestablish historical habitat access.
- Opportunity for funding partners.

1.2.3.3.5 Remediate Culverts and Road Crossings

The Project road system, specifically including culverts, is being evaluated for proper function. Initial analysis of the data indicates that the majority of the stream culverts are installed at or near the grade of the stream. While no anadromous fish-bearing streams reach any of the Project access roads, resident fish, including cutthroat trout, use the areas near the Project roads. Increased sediment transfer may be a factor in a small number of stream culverts with a history of erosion problems.

PGE estimated that it can replace a typical 30-ft-long culvert on the Project road system for about $3,500. PGE will contribute $17,500 for the remediation of culverts and crossings, or replace five culverts identified by the relicensing participants. Corrective actions for the crossings and/or culverts that are identified by NOAA Fisheries and the USFS will have the highest priorities. These corrective actions will focus on roads and culverts that are directly associated with the Project. PGE will seek funding partners to implement these actions, as appropriate. Work will be completed by the end of the in-water work period of 2003. PGE will adhere to NOAA Fisheries' Draft Anadromous Salmonid Passage Facility Guidelines and Criteria (2003) for culvert replacement. Construction procedures will be consistent with any NOAA Fisheries culvert replacement criteria in effect when this measure is implemented.

1.2.4 Studies to Address Critical Uncertainties

At the present time, there are a number of critical uncertainties regarding both the effects of the proposed action on listed salmonid stocks in the Clackamas River basin and the most effective way to remedy the adverse effects of the proposed action. During the interim period covered by this BO, a number of studies have been proposed to address those critical uncertainties so they may be addressed effectively during the consultation associated with relicensing activities in 2006. Table 2 provides a brief summary of the proposed studies. A more detailed list may be found in Appendix B.

Table 2. Studies to address critical uncertainties. See Appendix B for details.

	Subject	**Contractor**	**Category**	**Product**
1	Effects of hydropower Project on basin hydrology	GSE	Altered Flows	Reports
2	Reconnaissance level ramping study	McBain and Trush DE&S	Altered Flows	Report
3	Differences in macroinvertebrate community above and below Oak Grove Powerhouse	DE&S Aquatic Biology Associates	Altered Flows Habitat Elements	Report
4	Assessing potential Project effects on fluvial geomorphic processes on the Oak Grove Fork and mainstem Clackamas River upstream of North Fork Project	McBain and Trush	Channel Morphology	Reports
5	Evaluation of geomorphic and hydraulic process and historical changes from River Mill Dam to mouth of river	OSU USFS	Channel Morphology Substrate	Report
6	Lower Oak Grove and Clackamas River fish and habitat surveys	S.P. Cramer	Distribution Habitat Elements	Report
7	Field counts of spring chinook below Oak Grove Powerhouse	PGE	Distribution	Report
8	Spawning distribution of spring chinook in upper Clackamas River basin	R2	Distribution	Fish Passage EIA
9	Radiotelemetry study of passage route selection at River Mill Dam	Normandeau	Downstream Passage	Report
10	Assessment of adequacy of existing fish passage information	R2	Downstream Passage	Report
11	North Fork Spillway passage survival study	Normandeau	Downstream Passage	Report

12	Behavioral study of downstream migrating juvenile spring chinook in North Fork forebay	Normandeau	Downstream Passage	Report
13	Engineering evaluation to develop and refine options for excluding fish from turbines and guiding them to non-turbine passage routes at North Fork	PGE DE&S	Downstream Passage	Detailed conceptual drawings and cost estimates
14	Literature review to evaluate fish guidance efficiency of downstream juvenile bypass	R2	Downstream Passage (Barrier)	Fish Passage EIA
15	Review performance of screens at existing facilities	R2	Downstream Passage (Barrier)	Summary Report
16	Evaluation of PIT-tag data to assess fish bypass efficiency and winter survival at North Fork Dam/Reservoir	S.P. Cramer	Downstream Passage (Barrier)	Summary Report
17	Engineering evaluation to develop and refine options for excluding fish from turbines and guiding them to non-turbine passage routes at River Mill	DE&S	Downstream Passage	Detailed conceptual drawings and cost estimates
18	Engineering evaluation to develop and refine options for excluding fish from turbines and guiding them to non-turbine passage routes at Faraday	DE&S	Downstream Passage	Detailed conceptual drawings and cost estimates
19	Engineering evaluation to develop and refine options for guiding fish upstream at River Mill	DE&S	Downstream Passage (Barrier)	Detailed conceptual drawings and cost estimates
20	Literature review of fish exclusion methods	PGE LVA	Downstream Passage (Barrier)	Summary Report
21	North Fork juvenile bypass evaluation	R2 PGE	Downstream Passage	Part of Fish Passage EIA listing Report of Field study

22	Refinement of existing spreadsheet model for evaluation of mortality via all passage routes at each mainstem facility	R2	Downstream Passage	Model Refinements/ modeling output
23	Feasability analysis of barrier net implementation in North Fork forebay	PGE DE&S	Downstream Passage	Feasability analysis report
24	Literature review of survival of fish passing over Faraday spillway	R2	Downstream Passage (Barrier)	Fish Passage EIA
25	Literature review of hatchery and wild fish interactions in the Clackamas River	LVA	Ecological Factors	Report
26	Effect of Project operations on riverine habitat and gravel/LWD distribution	DE&S McBain and Trush	Habitat Elements Channel Morphology	Reports
27	Longitudinal changes in macroinvertabrate communities and presence of sensitive taxa	DE&S Aquatic Biology Associates	Habitat Elements	Report
28	Evaluation of fry rearing in North Fork Reservoir from existing information	R2 TBD	Habitat Distribution	Fish passage EIA TBD
29	Effect on Project operations on habitat and gravel/LWD distribution	McBain and Trush	Substrate LWD Channel Morphology	Report
30	Radiotelemetry studies of steelhead upstream migration routes	PGE	Upstream Passage (Barrier)	Report
31	Documentation of River Mill fish ladder, establishing consensus on ladder inadequacy	R2 Fish passage subgroup	Upstream Passage (Barrier)	Fish passage EIA Letter

32	Field water quality studies and model development	DE&S	Water Quality-Contaminants and Temperature	Reports Qual-W2 water quality model
33	Stream shade measurements	EDAW	Water Quality-Temperature Habitat Elements	Data
34	Effects of Project structures and operations on water temperature	DE&S	Water Quality-Temperature	Reports Qual-W2 water quality model
35	Effects of Project operations on biological availability of toxicants	DE&S	Water Quality-Contaminants	Report

1.3 Term of this Biological Opinion

The current license for the Clackamas River Hydroelectric Project expires on August 31, 2006. PGE has filed a notice of its intent to seek a new license from FERC and activities related to Project relicensing are currently underway. The proposed actions are intended to complete modifications of Project structures and operations and implement proposed conservation measures in the near term rather than waiting for relicensing. Thus, this BO analyzes actions to be implemented through the expiration of the current license on August 31, 2006. At that time, NOAA Fisheries expects that another BO developed pursuant to a consultation with FERC relating to the relicensing of the Project will supercede this BO.

This BO assumes that, to the extent that studies required in this BO identify additional mitigation measures, such mitigation will be included in the BO for the new license and implemented during the new license term. Starting annually in August 2006, if FERC has not issued a new license, NOAA Fisheries shall analyze PGE's annual report to determine if reinitiation of consultation is required. In any event, a new consultation will be required for any FERC relicensing action.

2. ENDANGERED SPECIES ACT

2.1 Biological Opinion

The objective of this BO is to determine whether FERC's issuance of a license to PGE for operation of the North Fork and Oak Grove hydroelectric projects is likely to jeopardize the continued existence of UWR chinook salmon, LCR chinook salmon, or LCR steelhead. As explained below in Section 2.1.1, NOAA Fisheries evaluates the impact of the Project on habitat in its jeopardy analysis.

This BO does not include a critical habitat analysis, because critical habitat designations for this ESU were recently vacated by court order. On February 16, 2000, NOAA Fisheries designated critical habitat for 19 ESUs of chinook, chum, and sockeye salmon as well as steelhead trout in Washington, Oregon, Idaho, and California. On September 27, 2000, NOAA Fisheries approved Amendment 14 to the Pacific Coast Salmon Fishery Management Plan designating marine and freshwater essential fish habitat for Pacific salmon pursuant to the MSA. Shortly after these designations, the National Association of Homebuilders filed a lawsuit challenging the designations on a number of grounds. On April 30, 2002, the United States District Court for the District of Columbia adopted a consent decree resolving the claims in the lawsuit. Pursuant to that consent decree, the court issued an order vacating the critical habitat designations, but retaining the MSA essential fish habitat designations. National Association of Homebuilders, et al. v Evans, Civil Action No. 00-2799 (CKK)(D. D.C., April 30, 2002). Thus, the critical habitat designation for LCR steelhead and LCR and UWR chinook is no longer in effect. NOAA Fisheries intends to reissue critical habitat designations. Reinitiation of consultation will be required if the proposed action affects critical habitat designated after consultation has been completed. 50 CFR §402.16(d).

2.1.1 Evaluating Proposed Actions

The standards for determining jeopardy and destruction or adverse modification of critical habitat are set forth in Section 7(a)(2) of the ESA as defined by 50 CFR §402.02 (the consultation regulations). In conducting analyses of habitat-altering actions under Section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations combined with the Habitat Approach (NMFS 1999): (1) consider the status and biological requirements of the species; (2) evaluate the relevance of the environmental baseline in the action area to the species' current status; (3) determine the effects of the proposed or continuing action on the species, and whether the action is consistent with the available recovery strategy; (4) consider cumulative effects; and (5) determine whether the proposed action, in light of the above factors, is likely to jeopardize the continued existence of species survival. In completing this step of the analysis, NOAA Fisheries determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the ESA-listed species. If jeopardy is found, NOAA Fisheries will identify reasonable and prudent alternatives for the action that avoid jeopardy.

Recovery planning will help identify measures to help conserve listed salmonids and increase their survival at each life stage. NOAA Fisheries also intends recovery planning to identify the areas/stocks most critical to species conservation and recovery and to thereby evaluate proposed actions on the basis of their effects on those factors.

2.1.1.1 Description of the Action Area

An action area is defined by NOAA Fisheries regulations (50 CFR §402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." With the exception of the Oak Grove Fork, the upstream limits of the action area in this decision correspond with the upstream limits of distribution of steelhead and chinook salmon in the Clackamas River basin. On the Oak Grove Fork, the upstream limit is Timothy Lake. Although there is a barrier waterfall downstream of Timothy Lake blocking anadromous fish access, lake operations and management influence flows and water temperature in the Oak Grove and North Forks of the Clackamas River. The downstream limits of the action area for the proposed action is the confluence of the Willamette and Columbia rivers.

The upstream limit is defined to correspond with the upstream limits of chinook salmon and steelhead distribution in most parts of the Clackamas because of the effects of the Project on salmonid populations reaching the spawning ground. These Project factors affect stream nutrient levels, which in turn affect the salmonid productivity of the Clackamas River. The Project may kill, injure, or delay upstream migrating salmonids.

The downstream limit was established because the Project alters the timing and volume of flows discharged by the Clackamas River. As the largest tributary to the Willamette River below Willamette Falls, this has an effect on the flows of that river below its confluence with the Clackamas, which can affect listed salmon and steelhead by changing flow levels in the lower Willamette River. Based on USGS (1993) flow records, the Clackamas River accounts for 9-14% of the total flows of the Willamette River downstream of Willamette Falls. Flows from the Clackamas River account for 0.6-2% of the total flow of the Columbia River downstream of the Willamette confluence.

2.1.1.2 Biological Requirements

The first step NOAA Fisheries uses when applying the ESA Section 7(a)(2) to the listed ESUs considered in this BO is to define the species' biological requirements. Biological requirements within the action area are a subset of the range-wide biological requirements of the ESU. Identification of the range-wide biological requirements provides context for subsequent evaluation of action area biological requirements.

Relevant biological requirements are those necessary for the listed ESUs to survive and recover to naturally reproducing population sizes at which protection under the ESA would become unnecessary. This will occur when populations are large enough to safeguard the genetic diversity of the listed ESUs, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment. McElhaney et al. (2000)

describe the biological requirements of salmonid populations, which are the components of ESUs, as adequate abundance, productivity (population growth rate), spatial scale, and diversity. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle.

In its co-manager review draft, the Willamette/Lower Columbia Technical Recovery Team (WLCTRT) has determined that there were at least 31 historical, demographically independent populations within the LCR chinook ESU (WLCTRT 2002a). One of these populations is the Clackamas River fall-run population. The WLCTRT has also identified 7 independent populations within the UWR chinook ESU, including a Clackamas River spring-run population. The WLCTRT also indicated possible subpopulations in the Collawash River and the Upper Clackamas River. The WLCTRT identified 23 populations of LCR steelhead, including the Clackamas River winter-run population. Possible subpopulations include spawners in Johnson Creek, Eagle Creek, and the Collawash River, and the combination of mainstem and upper Clackamas River winter-run steelhead.

The WLCTRT has not yet identified target abundance levels that are indicative of viable Clackamas River populations of UWR chinook, LCR chinook, and LCR steelhead in the Clackamas River. The WLCTRT is currently in the process of defining a number of specific viability criteria for these populations, which will be useful for determining if population-level biological requirements are being met. WLCTRT (2002b) discusses a number of potential criteria in the areas of population adult growth rates and abundance criteria, juvenile outmigrant growth rate criteria, within-population spatial structure criteria, and within-population diversity criteria.

The WLCTRT has not determined the degree to which viability of the three Clackamas populations identified above are necessary for ESU viability. WLCTRT (2002b) identified three criteria for ESU viability:

- Every stratum (life history and ecoregion combination) that historically existed should have two populations, or 50% of the historical populations, whichever is greater, that meet or exceed all the criteria for a viable population.
- Within a stratum, populations should be selected to include "core" populations that were historically most productive, retain genetic diversity, and minimize susceptibility to catastrophic events.
- All extant populations, even those which are not restored to fully viable status, should be maintained at least at the current population level or an effective population size of 500 fish, whichever is greater.

For the purposes of this consultation, and until superceded by determinations of the WLCTRT, NOAA Fisheries assumes that the viability of the three listed populations in the action area is necessary for the viability and recovery of their respective ESUs. For the ESU to survive and recover, adequate habitat and life-stage specific survival rates must occur within the action area. As described in NOAA Fisheries (NMFS 1999, "Habitat Approach"), there is a strong causal link between habitat modification and the response of salmonid populations. Those links are often difficult to quantify. In many cases, NOAA Fisheries must describe biological requirements in terms of habitat conditions in order to infer the populations' response to the effects of the action. To survive and recover, a wide-ranging salmonid ESU must have adequate habitat available for each life history stage.

For this consultation, the relevant biological requirements are important habitat elements that function to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and growth and development to the smolt stage. These important habitat elements for UWR and LCR chinook and LCR steelhead are: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food (juvenile only), (8) riparian vegetation, (9) space, and (10) safe passage conditions. The Project activities are likely to affect each of these habitat elements. The majority of these important habitat elements are included in an analysis framework called *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale* (hereafter referred to as the "matrix") for making effects determinations at the watershed scale (NMFS 1996). NOAA Fisheries uses the matrix to evaluate the environmental baseline condition, and effects of the action on important habitat elements for affected UWR and LCR chinook and LCR steelhead.

2.1.1.3 Status of Species

NOAA Fisheries considers the current status of the listed species, taking into account population size, trends, distribution, and genetic diversity. To assess the current status of the listed species within the action area, NOAA Fisheries starts with the determinations made in its decision to list for ESA protection the ESU considered in this BO and also considers any new data that is relevant to the determination. This section covers listing status, general life history, and population dynamics of species.

Three species of salmon and steelhead are found in the Clackamas River basin. Listed species in the action area include chinook (spring and fall), and steelhead. Specific status and ESU of each species and references are given in Table 3.

Table 3. ESA status of anadromous salmonids present in the Clackamas River basin.

Species	ESU	Status	Protective Regulations
Chinook Salmon *Oncorhynchus tshawytscha* (spring)	Upper Willamette River	Threatened	64 Fed. Reg.14308 March 24, 1999 65 Fed. Reg. 42422 July 10, 2000
Chinook Salmon *Oncorhynchus tshawytscha* (fall)	Lower Columbia River	Threatened	64 Fed. Reg.143086 March 24, 1999 65 Fed. Reg. 42422 July 10, 2000
Coho Salmon *Oncorhynchus kisutch*	Southwest Washington/ Lower Columbia River	Candidate	60 Fed. Reg. 38011 July 25, 1995
Steelhead Salmon *Oncorhynchus mykiss*	Lower Columbia River	Threatened	63 Fed. Reg.13347 March 19, 1998 65 Fed. Reg. 42422 July 10, 2000

2.1.1.3.1 LCR Chinook ESU

Geographic Boundaries and Spatial Distribution

This ESU includes all native populations of chinook from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls, and Clackamas River basin spring chinook. The eastern boundary for this ESU is Celilo Falls, the western edge of the arid Columbia basin ecosystem. Celilo Falls may have presented a seasonal migrational barrier to chinook salmon before it was flooded by The Dalles Reservoir.

Available information suggests that spring-run chinook salmon presently in the Clackamas and Sandy rivers are predominantly the result of introductions from the UWR ESU and are thus probably not representative of spring-run chinook salmon historically found in these two rivers.

Habitat and Hydrology

The Columbia River exerts a dominant influence on the biota of the Pacific Northwest, although smaller, regional distinctions exist within the basin. The Clackamas River is a tributary to the Willamette River joining the Willamette River below the Willamette Falls. It is the only major Willamette tributary included in this ESU.

All basins are affected (to varying degrees) by habitat degradation. Major habitat problems are related primarily to blockages, forest practices, urbanization in the Portland and Vancouver areas, and agriculture in floodplains and low-gradient tributaries. Substantial chinook salmon spawning habitat was blocked or passage substantially impaired by construction of dams on tributaries during the first half of the twentieth century (WDF et al. 1993; Kostow 1995). Freshwater habitat is in poor condition in many basins, with problems related to forestry practices, urbanization, and agriculture.

Hatchery Influence

Starting in the early 1900s, hundreds of millions of chinook fry were released into the lower Columbia by Washington State, Oregon State, and Federal hatcheries. At present, about 25 ODFW, WDFW, and USFWS hatcheries release chinook salmon in this ESU. Available evidence indicates a pervasive influence of hatchery fish on both spring- and fall-run natural populations throughout this ESU (Howell et al. 1985; Marshall et al. 1995). Eggs exchanged between hatcheries in this ESU caused extensive genetic homogenization of hatchery stocks (Utter et al. 1989). Hatchery programs are widespread throughout the region, and most populations are maintained to a significant extent via artificial propagation (Howell et al. 1985; WDF et al. 1993; Kostow 1995). The life-history characteristics of spring- and fall-run populations in many rivers have probably been influenced, to varying degrees, by transfers of non-indigenous stocks.

Harvest

Harvest rates on fall-run stocks are moderately high, with an average total exploitation rate of 65% (1982-89 brood years) (PSC 1994). The average ocean exploitation rate for this period was 46%, while the freshwater harvest rate on the fall run averaged 20%, ranging from 30% in 1991 to 2.4% in 1994. Harvest rates are somewhat lower for spring-run stocks, with estimates for the Lewis River averaging 24% ocean and 50% total exploitation rates in 1982-89 (PSC 1994). In-river fisheries harvest about 15% of the lower river hatchery stock, 29% of the lower river wild stock, and 58% of the Spring Creek hatchery stock (PFMC 1996). The average inriver exploitation rate on the stock as a whole is 29% (1991-95).

Population Trends

We have no estimates of historic abundance for this ESU, but there is widespread agreement that natural production has been substantially reduced over the last century. The large numbers of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish. In spite of the heavy impact of hatcheries, genetic and life-history characteristics of populations in this ESU still differ from those in other ESUs. The Biological Recovery Team (BRT), however, identified the loss of fitness and diversity within the ESU as an important concern. Long-term trends in escapement for the fall run are mixed, with most larger stocks positive, while the spring run trends are positive or stable. Short-term trends for both runs are more negative. The BRT concluded that chinook salmon in this ESU are not presently in danger of extinction, but are likely to become so in the foreseeable future. Estimated overall abundance of chinook salmon in this ESU is not cause for immediate concern. Production in this ESU appears to be predominantly hatchery-driven with few identifiable native, naturally reproducing populations. Long- and short-term trends in abundance of individual populations are mostly negative, some severely so.

2.1.1.3.2 UWR Chinook ESU

Geographic Boundaries and Spatial Distribution

This ESU includes native spring-run populations above Willamette Falls. Spring chinook in the Clackamas River basin were added to the UWR ESU because available information suggests that spring-run chinook salmon presently in the Clackamas and Sandy rivers are predominantly the result of introductions from the UWR ESU and are thus probably not representative of spring-run chinook salmon historically found in these two rivers (NMFS 1998).

Historical Information
Historically, only spring-run fish were able to ascend Willamette Falls to access the UWR (Fulton 1968). Following improvements in the fish ladder at Willamette Falls in the 1950s, some 200 million fall-run chinook salmon have been introduced into this ESU. The UWR has received relatively few introductions of non-native spring-run fish. Hatcheries on the upper Willamette include McKenzie, Marion Forks, South Santiam, and Willamette. Transfers of millions of eggs from various populations in the UWR basin among these hatcheries has caused a loss of local genetic diversity and the formation of a single breeding unit in the Willamette River basin (Kostow 1995). Straying rates are high, with an estimated two-thirds of natural spawners of hatchery origin (Nicholas 1995). Introduced fall-run chinook salmon have also successfully spawned in the UWR (Howell et al. 1985).

Habitat and Hydrology
The geography and ecology of the Willamette Valley is considerably different from surrounding areas. Historically, the Willamette Falls offered a narrow temporal window, with flows becoming too low for passage of Willamette Falls in the late summer. This limit to upriver migration may have promoted isolation from other Columbia River stocks. Risks to UWR chinook include dams which block large areas of spawning and rearing habitat, and degradation of accessible habitat by thermal effects of dams, forestry practices, agriculture, and urbanization. Water diversions, dam placements, and river channelization may have altered the abundance, spawning and rearing distribution, and smolt timing of populations of spring-run chinook salmon from historical levels. Water quality is impacted by agricultural and urban activities. Many water quality problems are exacerbated by low water flows and high temperatures during the summer. Pulp and paper mill discharges of dioxin into the Columbia and Willamette rivers were cited as another water quality concern, although this situation has been much more serious in the past (USGS 1993).

Hatchery Influence
Dam construction and habitat degradation in the Clackamas River basin nearly eliminated the spring run of chinook salmon. Restoration efforts for the Clackamas River chinook used transfers of McKenzie River spring-run chinook salmon raised at the USFWS Eagle Creek Hatchery (built in 1957) and the ODFW Clackamas Hatchery (built in 1979) (Delarm and Smith 1990a,b). Between 1975 and 1987, about 1.2 million spring-run chinook were released from Eagle Creek National Fish Hatchery (NFH). The Clackamas River Hatchery continues to produce between 0.5 and 1.2 million fish per year (NRC 1996). Spring-run chinook salmon currently inhabiting the Clackamas River are thought to most closely resemble the homogenized breeding of Willamette River hatchery populations (Cramer et al. 1996).

Due to the large and continuous nature of artificial propagation programs in the Willamette River system, wild populations are thought to be small and "vastly dominated by hatchery fish" (Kostow 1995, p. 44). Hatchery fish have been observed spawning in the wild and appear to be successfully reproducing (Cramer et al. 1996).

Harvest
Total harvest rates on stocks in this ESU are moderately high, with the average total harvest mortality rate estimated to be 72% in 1982-89, with a corresponding ocean exploitation rate of 24% (PSC 1994). This estimate does not fully account for escapement, and ODFW is in the process of revising harvest rate estimates for this stock; revised estimates may average 57% total harvest rate, with 16% ocean and 48% freshwater components (Kostow 1995). The inriver recreational harvest rate (Willamette River sport catch/estimated run size) for the period of 1991 through 1995 was 33% (PFMC 1996).

Population Trends
Long-term trends of escapement are mixed, ranging from slightly upward to moderately downward. Short-term trends are all strongly downward. The majority of the Willamette River fish are hatchery produced. The BRT concluded that chinook salmon in this ESU are not presently in danger of extinction, but are likely to become so in the foreseeable future. Total abundance has been relatively stable at about 20,000 to 30,000 fish; however, recent natural escapement is less than 5,000 fish and has been declining sharply. Furthermore, it is estimated that about two-thirds of the natural spawners are first-generation hatchery fish, suggesting that the natural population is falling far short of replacing itself. The BRT noted a similarity between these population dynamic parameters and those for the Upper Columbia River steelhead ESU, which was recently listed as endangered by NOAA Fisheries.

NOAA Fisheries (1998b) has identified the following factors as contributing to the decline of chinook in the UWR ESU: loss of access to substantial amounts of spawning habitat; increased water diversions; extensive genetic homogenization of hatchery, natural, and potential stocks; increased forestry, agriculture, mining, and urbanization; moderately high harvest rates of fall-run stocks; and straying.

2.1.1.3.3 LCR Steelhead ESU

Geographic Boundaries and Spatial Distribution
The LCR steelhead ESU includes tributaries to the Columbia River between the Cowlitz and Wind rivers in Washington and the Willamette and Hood rivers in Oregon, inclusive. Steelhead in the UWR basin above Willamette Falls are not part of this ESU. The LCR ESU comprises both winter and summer steelhead. Non-anadromous *O. mykiss* co-occur with the anadromous form in LCR tributaries; however, the relationship between these forms in this geographic area is unclear. Life history attributes for steelhead within this ESU appear to be similar to those of other West Coast steelhead. Steelhead populations in this ESU are of the coastal genetic group (Schreck et al. 1986; Reisenbichler et al. 1992; Chapman et al. 1994), and a number of genetic studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River basin. Genetic data also show steelhead from this ESU to be distinct from steelhead from the UWR and from coastal streams in Oregon and Washington. Recent genetic data from WDFW also show clear differences between samples from the Wind, Washougal, and Big White Salmon rivers and those from the coast of southwest Washington.

Habitat and Hydrology

Steelhead-bearing rivers within this geographical region drain the Cascade Mountains from Mount Rainier to Mount Hood, including the Toutle River that was greatly impacted by the eruptions of Mount St. Helens in the 1980s. Significant habitat blockages resulted from dams on the Sandy River, and minor blockages (such as impassable culverts) are likely throughout the region. Habitat problems for most stocks in this ESU are similar to those in adjacent coastal ESUs. Clearcut logging has been extensive throughout most watersheds in this area, and urbanization is a substantial concern in the Portland and Vancouver areas. Because of their limited distribution in upper tributaries, summer steelhead appear to be at more risk from habitat degradation than are winter steelhead.

Hatchery Influence

More than 2 million winter steelhead and over 1 million summer steelhead smolts are released each year within the basins occupied by the LCR ESU. The primary winter steelhead stocks used in hatchery programs in the LCR are from Eagle Creek and Gnat Creek hatcheries in Oregon, and Beaver Creek (Elochoman River/Chambers Creek origin) and the Cowlitz River in Washington (Howell et al. 1985). Chambers Creek winter steelhead from Puget Sound are also an important component of LCR hatchery management (Howell et al. 1985).

Harvest

There is a very popular sport steelhead fishery on the Clackamas River. However, all hatchery steelhead are now fin-clipped and it is illegal to retain wild steelhead. Other than hooking mortality during catch and release, there appears to be little negative effect from harvest on wild LCR steelhead populations in the action area.

Population Trends

Given the relatively low natural run sizes to individual streams, the preponderance of negative trends in abundance, and the apparent substantial contribution of hatchery fish to production, the BRT had substantial concern that the majority of natural steelhead populations in this ESU (both winter and summer) may not be self-sustaining. The major present threat to genetic integrity for steelhead in this ESU comes from past and present hatchery practices.

Previous assessments within this ESU have identified several stocks as being at risk or of special concern. Nehlsen et al. (1991) identified 19 stocks as at risk or of concern. WDF et al. (1993) considered 23 stocks within the ESU, of which 19 were considered to be of native origin and predominantly natural production. The status of these 19 stocks was 2 healthy, 10 depressed, and 7 unknown. All 4 of the remaining (not native/natural or unknown origin) stocks were classified as depressed.

NOAA Fisheries estimated the short-term (i.e., 24 years) extinction risk for Clackamas populations of LCR steelhead to be less than 5% (NMFS 2000b). The annual population growth rate has been 0.37-0.88 from 1980 through 1999, depending upon assumptions about reproductive success of hatchery fish spawning in the wild, and upon differences between summer and winter steelhead stocks.

The BRT concluded that the LCR steelhead ESU is not presently in danger of extinction, but is likely to become endangered in the foreseeable future. The major area of uncertainty in this evaluation is the degree of interaction between hatchery and natural stocks within the ESU.

2.1.1.4 Environmental Baseline

The environmental baseline includes "the past and present impacts of all Federal, state, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of state and private actions that are contemporaneous with the consultation in progress" (50 CFR §402.02). In step 2 of NOAA Fisheries' analysis, we evaluate the relevance of the environmental baseline in the action area to the species current status. In describing the environmental baseline, NOAA Fisheries emphasizes important habitat indicators for the listed salmonid ESU affected by the proposed action. The action area is described in Section 2.1.1.1 of this document. NOAA Fisheries does not expect any other areas to be directly or indirectly affected by the proposed action.

2.1.1.4.1 Status of Species within the Action Area

The current status of populations of the three listed ESUs that occur in the action area are addressed in detail in Appendix A. All three populations show signs of decline associated with degraded habitat, barriers to migration, and other anthropogenic effects.

2.1.1.4.2 Physical Description and Status of Habitat Within the Action Area

Physical Description of the Clackamas River Subbasin
The basin headwaters originate among the young basaltic volcanoes of the Oregon Cascades. Downstream, lava flows from those volcanoes form ridges and canyons that confine the route of the Clackamas River. Most of the Project area experiences a temperate climate, typified by wet winters and dry summers. The higher elevations of the Timothy Lake area experience cooler conditions. The lower Clackamas River basin receives about 60 inches (154 cm) of precipitation annually and the upper basin typically receives more than 70 inches of precipitation. The basin also receives a large amount of snowfall, ranging from 4-8 inches at lower elevations up to 278 inches on the slopes of Mount Hood. The primary source of flow in the Clackamas River is snowfall from the upper basin. The Oak Grove Fork subbasin is within a rain-on-snow zone. In this area, heavy rain and snowfall produces high peak flows, debris torrents, and landslides. The upper basin comprises the forested slopes of the Cascades. Forest cover is typically second or older growth forest.

Near the town of Estacada, the character of land use and cover changes. Downstream of Estacada, the Clackamas River is bordered by agricultural landscape with gradually increasing urban development as it flows through the cities of Clackamas, Gladstone, and Oregon City before joining the Willamette. The lower portion and mouth of the river are located in the southern portion of the Portland metropolitan area. Development in this area is not as dense as much of the Portland area, but there appears to be a trend towards increasing development.

The Clackamas River drains a 934-mi^2 (2,419-km^2) watershed on the western slope of the Cascade Range in northwest Oregon. It flows 83 mi (134 km) from its headwaters to its confluence with the Willamette River at (Willamette River) RM 24.8. Major tributaries to the Clackamas River include Clear Creek, Deep Creek, Eagle Creek, North Fork, Roaring River, Fish Creek, Collawash River, and the Oak Grove Fork. Flow in the Clackamas River originates primarily from snowmelt from the upper watershed.

The basin headwaters are set among young basaltic volcanoes of the High Cascades. Downstream, lava flows from these young volcanoes form ridges and canyons that confine the Clackamas River. Most of the Project vicinity experiences temperate climatic conditions, typified by wet winters and dry summers. The higher elevations occupied by the Timothy Lake area typically experience cooler conditions. The lower Clackamas River basin receives about 60 inches (154 cm) of precipitation annually, while higher elevations in the basin typically receive more than 70 inches (179 cm) of precipitation. Average annual snowfall in the basin ranges from about 4 to 8 inches (10 to 21 cm) in the lower elevations to more than 100 inches (256 cm) at higher elevations (average annual snowfall at Government Camp, just outside the basin, is about 278 inches [713 cm]). The Oak Grove Fork watershed lies within a rain-on-snow zone, where runoff generated by heavy rains combined with snowmelt produces peak flows, debris torrents, and sudden landslides.

The upper 70% of the watershed is situated within Mt. Hood National Forest and is managed by the USFS. Smaller portions of the watershed are managed by the BLM (2%) and the State of Oregon (< 0.1%). The Confederated Tribes of Warm Springs also own forest lands in the upper watershed (about 2%). The middle region of the Clackamas River basin includes agricultural, forestry, power generation, and rural residential uses. The lower watershed, between Estacada and the Willamette River, is the most highly developed area within the watershed, especially in the suburban areas near the mouth of the Clackamas River. Industrial uses in the lower watershed include food processing, recycling of volatile organic compounds, feedlot and dairy farm operations, and rock and aggregate mining (CRWDMS 1996).

Between 1909 and 2000, annual mean flows in the Clackamas at Estacada, Oregon, ranged from 1,513-4,145 cfs. Peak flows were observed to exceed 60,000 cfs. The general pattern of flows in the lower river is similar to rainfall patterns. Minimum flows occur in August and September, increasing to maximum flows in December to January. Flows then decrease slightly, but remain high through May and then decrease in June (USGS 1993).

2.1.1.4.3 Baseline Conditions

Water Quality: Temperature

NOAA Fisheries has identified water quality as a properly functioning condition (PFC) pathway. PFC indicators of water quality include water temperature, sediment/turbidity, and chemical contaminants/nutrients. Adequate water quality and water temperatures are also essential elements of designated critical habitat (NMFS 2000a). Existing information on baseline water quality and water temperature and effects of existing Project operations on water quality and water temperature are summarized below. In addition, water quality and water temperature and the effects of Project operations on water quality and water temperature are being evaluated through ongoing studies and modeling efforts as part of the relicensing process. A water quality model (CE-QUAL-W2) is currently being developed to: (1) identify factors that influence temperature and water quality, (2) determine Project-induced changes to water temperature and water quality regimes, and (3) identify potential effects of existing and proposed Project operation on aquatic biota.

Oak Grove Project

The Oak Grove Project affects water temperature in the Oak Grove Fork between Timothy Lake and Lake Harriet, downstream of Lake Harriet, and in the mainstem Clackamas River upstream and downstream of the Oak Grove Powerhouse. The USFS (1996) states that water temperatures in the reach between Timothy Lake and Lake Harriet remain cool throughout the summer, but a description of the data upon which this finding is based is not included in the report. The USFS (1996) report also states that water temperatures downstream of Lake Harriet, where minimum flows are not required, have increased as a result of low instream flows, but that this increase may benefit rearing coho salmon. The Clackamas Fish and Aquatics Workgroup is currently conducting field studies to characterize and model the effects of the Project, including the Oak Grove Project, on water temperature dynamics.

North Fork Project

The North Fork Project (including the North Fork, Faraday, and River Mill developments) affects water temperatures in the Clackamas River downstream of each of the three dams. Potential impacts on temperatures in the Clackamas River have been identified as a concern by the Clackamas River Fisheries Working Group (Turner 1997). In addition, Oregon Department of Environmental Quality (ODEQ) includes the Clackamas River from River Mill Dam to the confluence with the Willamette River on the Section 303(d) list of impaired water bodies for exceeding the summer water temperature criteria of 64˚F (17.8˚C) for salmonid rearing.

Historical data on river temperatures before completion of the North Fork, Faraday, and River Mill developments are not available. Since 1996, PGE has monitored water temperatures at several locations, including upstream of North Fork Reservoir at Armstrong Bridge (RM 41.6), the head of North Fork Reservoir (RM 34), the North Fork Powerhouse tailrace (RM 31), the Faraday-North Fork fish ladder (RM 28.5), the Faraday Powerhouse intake (RM 26), and the River Mill Powerhouse tailrace (RM 23). Bullock and Turner (1998) evaluated downstream change in mean monthly water temperature in August and September 1997 from Armstrong Bridge to the River Mill Powerhouse tailrace and found that the increase in water temperature per mile was three to five times greater within North Fork Reservoir than it was upstream or downstream of the reservoir.

The Fish and Aquatics Workgroup is currently conducting additional field studies to characterize and model the effects of the Project on water temperature dynamics. Analysis of the complete data set is not yet available. Available analysis of water temperatures for 2000 is shown in Table

7.3 of the BE. These preliminary data indicate that the 7-day average water temperature upstream of North Fork Reservoir remained below the ODEQ 17.8ºC temperature criterion throughout the year, with the exception of one tributary to Timothy Lake in which the criterion was exceeded for 3 days. Water temperatures in the Faraday-North Fork fish ladder, however, exceeded the criterion for 16 days at the top of the ladder and for 8 days at the bottom of the ladder. The hottest temperatures at the top of the ladder were recorded in August; the hottest temperatures at the bottom were recorded in July. Downstream of River Mill Dam, the 7-day average water temperature exceeded the ODEQ criterion for 6 days in the River Mill Dam tailrace (RM 23.3), for 49 days upstream of Eagle Creek (RM 16.5), for 71 days at Carver Bridge (RM 7.9), and for 4 days at Oregon City (RM 2.5) (PGE 2001b).

Water Quality: Sediment/Turbidity
NOAA Fisheries defines low turbidity as PFC, not exceeding Oregon State water quality standards, for this factor. Suspended sediment and turbidity levels within the action area have not been identified as exceeding levels for the PFC.

Water Quality: Contamination
NOAA Fisheries defines PFC as low levels of contamination with no 303(d) designated reaches. The category "at risk" is defined as one 303(d) designated reach. The 2002 Oregon 303(d) list identifies RM 0-15 as exceeding standards for fecal coliforms. There are a number of potential sources of contamination in the lower Clackamas River; however, none have been identified as the source of the contamination. The Clackamas River receives effluent from Estacada and Clackamas waste treatment plants and probably picks up some contaminants from non-point sources along its route. A risk of bioacculumation of mercury has also been identified in the North Fork Reservoir. With one 303(d) designated reach, the action area falls within the "at risk" category.

Habitat Access: Barriers
NOAA Fisheries defines PFC as a lack of any barriers being present, allowing upstream and downstream passage at all flows without significant levels of mortality or delay. Currently, there are no non-Project barriers to migration (upstream or downstream) on the Clackamas River. Historically, before the turn of the century, there was a small dam on the lower river which at least partially blocked passage. Other non-Project historical barriers include the various fish weirs erected to collect eggs for hatchery operations. These weirs were noted not to be very efficient and were less than total barriers to migration.

Historically, Clackamas River Project dams have impeded or totally blocked adult upstream migration because of non-existent or poorly functioning fish passage facilities. After a flood washed out the fish ladder in 1917, there was no fish passage above Faraday Dam until the facilities were rebuilt in 1939. Even when fish passage facilities have been in place and operating, there has been some doubt about their effectiveness.

Facilities for the passage of upstream migrating fish are currently provided at all of the dams within the North Fork Project. Upstream passage for fish is provided by two fish ladders: (1) the River Mill fish ladder, which provides passage over River Mill Dam into Estacada Lake; and (2) the Faraday-North Fork fish ladder, which spans 1.7 mi (2.7 km) and provides passage over both the Faraday Diversion Dam and North Fork Dam.

The Fish and Aquatics Workgroup considers downstream fish passage to be a major issue for evaluation during FERC relicensing. PGE is currently conducting studies to evaluate passage delays, injuries, and mortality, and will conduct additional studies during the relicensing process (PGE 2001b). As discussed above, PGE is also analyzing available PIT-tag data to assess downstream migration pathways and potential mortality.

The Clackamas River Project also causes increased mortality among downstream migrating smolts. Before the construction of juvenile bypass facility at North Fork Dam, the only route for juvenile downstream passage was through turbines or over spillways. On the Clackamas River, Project spill only occurred in response to high water, so most fish passed through the turbines. In the case of River Mill Dam and North Fork, passage over the spillway also causes high mortality of downstream migrating smolts.

Habitat Access: Barriers - Upstream

The River Mill fish ladder, originally built in 1912, was rebuilt in 1972 with the following modifications: enlargement of the lower section of the ladder, enhancement of attraction flows, and installation of a fish trap (this fish trap, however, was inefficient and was operated for only three years). Despite these modifications, the fish ladder at River Mill Dam does not meet current design criteria, and improving passage of adult spring chinook salmon adults over this ladder has been identified as an objective of ODFW's Clackamas River Subbasin Fish Management Plan (ODFW 1992). The ladder is considered to be too small and steep to facilitate upstream passage. PGE has evaluated passage of winter steelhead over River Mill Dam using radiotelemetry (Hanson et al. 2001). PGE is currently monitoring salmonid passage in the ladder using a video camera. The video documentation thus far shows a number of fish dropping downstream, indicating a reluctance of fish to move into the older section of the ladder.

After passing over River Mill Dam, upstream migrants either spawn in the 1.7-mi (2.7-km) reach of the Clackamas River between the head of Estacada Lake and the Faraday Diversion Dam, are harvested in this reach, or continue upstream via the Faraday-North Fork fish ladder. Adult fish can traverse the entire 1.7-mi (2.7-km) length of the ladder and exit into North Fork Reservoir or enter a trap near the base of the ladder, from which they are trucked and released upstream.

Recent research has focused on potential fish passage problems over and around the mainstem Project facilities. Results from recent studies indicate that significant delays in early run coho salmon migration may occur at the entrance to the Faraday-North Fork fish ladder. Gunsolus and Eicher (1970) evaluated the passage of juvenile and adult salmonids through the North Fork Project and found that salmon and steelhead successfully ascended the Faraday-North Fork fish ladder during most of the year, but that from late May through summer, spring chinook migrated only as far upstream as the fish trap. In 1987, a narrow portion of the fish ladder (at the adult fish counter) was modified, which improved passage for chinook salmon. From 1971 through 1987 (before the modification), an average of 11% of the chinook salmon reaching the ladder used the ladder instead of the trap. Since 1988 (after the modification), an average of 66% have used the ladder. All fish now pass through the trap. However, adult spring chinook salmon have been observed congregating below the Faraday Diversion Dam and small numbers of adults holding at the Faraday Powerhouse and in pools in the diverted reach between Estacada Lake and Faraday Diversion Dam (Gunsolus and Eicher 1970). These fish dispersed in September and either spawned in the immediate area, continued upstream, or they died.

In May 1999, four wild steelhead were captured and radio-tagged at River Mill Dam (Shibahara 2000a). The four steelhead were then released at the River Mill Dam forebay. The following day, all four fish were detected 4.7 mi upstream. Within 24 hours, they had migrated through Lake Estacada, past the Faraday Powerhouse, and through the diversion reach to the Faraday-North Fork fish ladder and the base of the Faraday Diversion Dam. Within three days of tagging, three of the four fish had ascended the fish ladder to the adult trap. The fourth fish remained below the ladder for 14 days; it was detected 1 mi above North Fork Reservoir on May 30, 15 days after being tagged and released.

Results of the 2000 coho radiotelemetry study (Shibahara et al. 2001) indicate that there may be delays for coho salmon at the Faraday-North Fork fish ladder. Forty-two adult early-run coho were captured at the River Mill fish ladder, radio-tagged, and then released. Fish moving upstream remained in the Faraday-North Fork fish ladder for an average of 2.3 days (range 0.3–13.0 days). Additional data from remote data logger sites in the Faraday-North Fork fish ladder indicate that fish may be delayed as long as 32 days at the entrance to the Faraday-North Fork fish ladder.

Concerns have also been raised about adult passage conditions in the bypass reach between the Faraday Powerhouse and the Faraday Diversion Dam. Channel morphology in certain sections of the bypass reach results in shallow flow conditions at the 100-cfs (2.8 cms) minimum passage flow. Stream habitat surveys conducted by PGE in August 1997 identified three locations in the bypass reach that may hinder adult upstream passage because of their shallow flow conditions. To improve fish passage conditions in this reach, PGE has occasionally used heavy equipment to excavate a narrow, deep channel adjacent to the Faraday Powerhouse. PGE evaluated winter steelhead delays in the bypass reach during the 1999–2000 and 2001 seasons by radio-tagging adult fish passing over the River Mill fish ladder.

Assessments of spill to stimulate migration were first initiated in 1980. In the summer of 1980 (the first year of returns from the Clackamas Hatchery), large numbers of spring chinook (hatchery and wild origin) and summer steelhead (hatchery origin) moved up the River Mill fish ladder and held between River Mill Dam and the Faraday Diversion Dam. In an attempt to stimulate migration past the Faraday Diversion Dam and North Fork Dam, PGE released three spills of 120 cfs (3.4 cms) over the Faraday Diversion Dam. All three periods of increased flow appeared to stimulate migration past North Fork Dam (Cramer 1993). From 1981 through 1988, additional summer spills were tested, using different volumes and frequencies. Results were variable and unpredictable, most often showing no change in fish passage. As a result, criteria were adopted to establish when spills are needed. According to these criteria, spills are provided when all three of the following conditions are met:

- The difference in adult spring chinook salmon counts between River Mill and Faraday-North Fork fish ladder is greater than 800.
- A large number of chinook salmon are present in the river between the Faraday Powerhouse and Faraday Diversion Dam.
- The average five-day count of chinook salmon over North Fork Dam is less than 25 fish.

These spill criteria were established to assist spring chinook by stimulating migration. Since the criteria were adopted in 1989, spill has been triggered only once, because numbers of returning chinook were low through the 1990s. In 2001, PGE spilled at the Faraday Diversion Dam when these criteria were met.

Habitat Access: Barriers - Downstream

Juvenile anadromous salmonids produced upstream of dams must pass through reservoirs and over or around dams or through turbines in their migration to the ocean. These impediments to migration can reduce outmigrant survival due to injury or mortality of juveniles passing through turbines or over spillways, and/or increased vulnerability to predation in reservoirs. Facilities designed to provide juvenile passage around dams is one method of reducing juvenile mortality associated with reservoir and diversion projects. Juvenile fish passage facilities and potential issues regarding these facilities are discussed below.

Access to the Oak Grove Fork by upstream-migrating anadromous salmonids is blocked by a 20-ft (6.1-m) waterfall one mile downstream of Lake Harriet Diversion Dam. The Oak Grove Project, therefore, does not affect downstream migration of juvenile anadromous fish and does not include facilities for the downstream passage.

Facilities for the passage of downstream migrating juveniles are provided at the North Fork and River Mill dams, but not at the Faraday Diversion Dam or the Faraday Powerhouse. The juvenile bypass facility at the North Fork Project consists of a surface collection system, the Faraday-North Fork fish ladder, a separator, an evaluation station, and a bypass pipeline. Juvenile salmonids migrating downstream from the upper Clackamas River are attracted to a surface collection facility in North Fork Reservoir and are passed into the Faraday-North Fork fish ladder. Near the lower end of the 1.7-mi (2.7-km) fish ladder, the downstream migrants pass through a "separator," where they are screened out, passed through a PIT-tag detector, and then diverted into a downstream pipeline. The separator also collects a subsample of fish into a holding box where they are counted, passed through a PIT-tag detector, and measured before being released into the downstream pipeline. The juveniles then travel about 5 mi (8 km) through a pipeline that returns them to the river at the tailrace downstream of River Mill Dam. The pipe outlet is about 20 ft (6.1 m) above the water surface.

The North Fork Dam spillway is also partially screened to protect juvenile downstream migrants. Up to 1,000 cfs can be screened; however, impingement on screens has been observed at flows exceeding 250 cfs. Spilled flows are therefore limited to about 230 cfs through gate 21, which is screened to divert juveniles to the juvenile bypass facility. When spills exceed 230 cfs, one of the radial arm gates is opened six inches, which allows the passage of an additional 700 cfs. These gates cannot be opened to less than six inches because of vibration. Beyond 700 cfs, each of the radial arm gates can be adjusted in very small increments to their capacity of almost 30 ft (about 42,000 cfs). When spill drops, the process is reversed. Gate 21 is the last gate to close.

PGE examined whether the standard operating procedures at North Fork Dam are minimizing the spill that is occurring. Operations currently attempt to anticipate high flows and draw down North Fork Reservoir to avoid spill events. Minimizing the spill at North Fork Dam affords migrating juvenile salmonids the optimal opportunity to utilize the juvenile bypass system. Because North Fork Reservoir is very narrow and has little active storage, major runoff events on the Clackamas River overwhelm the influences of this storage.

Two studies that evaluated juvenile passage at the North Fork Project concluded that large numbers of salmonids exited North Fork Reservoir via the North Fork Dam spillway (Gunsolus and Eicher 1970; Fish Commission of Oregon 1974). Gunsolus and Eicher (1970) concluded that thousands of juveniles passed over the North Fork Dam spillway during some spills and may ultimately have passed through the Faraday Powerhouse turbines. They also concluded that in some years, the number of juvenile coho and chinook salmon passing downstream via the spillway may exceed those using the downstream juvenile bypass facility. The Fish Commission of Oregon (1974) estimated that 64% of the coho and 82% of the chinook migrating downstream in the 1969–1970 season passed over the North Fork Dam spillway and that 34.5% of the coho and 60.5% of the chinook passed through the Faraday Powerhouse turbines. Chinook passing through the spillway have injury rates ranging from 16.4% to 20.6%, exceeding those at other sites in the Columbia basin (Normandeau 2001). Survival is estimated at 87.3% (ranging from 79.8% to 95.7%) at 700 cfs and 80.1% (ranging from 70.5% to 91.3%) at 2,000 cfs. These injury rates are considered substantial impacts from passage through this route. In addition, mortality of fish passing through powerhouse turbines has been identified as substantial (Gunsolus and Eicher 1970). Gunsolus and Eicher (1970) estimated that mortality of coho passing through the North Fork Powerhouse turbines was 25.5% to 31.6% and concluded that further evaluation of downstream juvenile passage through the spillways and turbines was necessary.

To further evaluate downstream passage at the North Fork Project, PGE is analyzing PIT-tag data from juvenile salmonids released between 1995 and 2000 (Beamesderfer et al. 2001). During that time, over 24,000 PIT-tagged chinook, coho, and steelhead parr, pre-smolts, and smolts were released at sites in Fish Creek, Roaring River, Oak Grove Fork, North Fork, upper Clackamas mainstem, and Collawash River. The analysis of these data is ongoing, and results are preliminary. Results indicate that detection rates in the juvenile bypass facility are highly variable and are generally greatest for coho salmon and lowest for chinook salmon. Overall, of all salmonids tagged in the reservoir, 31% exited the reservoir via the juvenile bypass system. The remainder either shed their tags, passed through the turbines or spillway, died before passing the dam, or residualized. Significant numbers of juveniles apparently pass the North Fork Dam over the spillway in years when spill occurs. Spill at North Fork Dam is sporadic and generally occurs during winter high flow events. Spill during spring emigration periods is relatively uncommon, but significant numbers of juvenile salmonids apparently pass over the spillway during both winter and spring spills. Among the years analyzed, in years when spill occurred during spring, large numbers of steelhead and coho salmon tagged in the reservoir apparently passed over the spillway. During years with significant spill in winter, large numbers of chinook salmon, coho salmon, and steelhead appeared to use the spillway. In years of no spill, 87% of marked steelhead smolts passed North Fork Dam via the juvenile bypass facility; the remaining 13% either passed through the turbines, continued to rear upstream of the dam, or died without passing the dam.

ODFW (1992) identified the need to evaluate the mortality rate of juvenile steelhead and spring chinook salmon passing through the North Fork juvenile bypass system. PGE evaluated injury, descaling, and delayed mortality of juvenile salmonids passing through the North Fork juvenile bypass facility in 1997 and concluded that injury and mortality rates of juveniles passing through the bypass system were low (Turner 1998a). Of the 244 fish collected at the separator, 2 exhibited descaling, 2 had suffered recent injuries, and after 48 hours, one mortality was observed. Of the 186 fish collected at the outfall, there were two mortalities during the sampling, one mortality after 24 hours, and 3 fish were descaled. Some of the injury or mortality may have occurred as a result of sampling procedures or handling stress.

Prior to 1994, River Mill Dam provided no downstream passage facility for juveniles produced by adults that spawned between the Faraday Diversion Dam and River Mill Dam or juveniles that exited upstream reservoirs via dam spillways or powerhouse turbines. In 1994, PGE installed a downstream migrant facility consisting of a 4-inch-wide by 6-ft-high surface-oriented vertical slot cut in the trashracks on the upstream face of the dam and a funnel leading to a 10-ft-diameter pipe. Few fish, however, used this system, presumably because the entrance was too narrow. In 1996, PGE improved the facility by modifying the passage funnel to an 8-inch-wide by 3-ft-high configuration. Small sample sizes of PIT-tag recaptures at River Mill Dam have thus far prohibited quantitative analysis of downstream passage (Beamesderfer et al. 2001).

The effects of barriers noted in this section reduce the survival of downstream migrants. Passage through turbines, spillways, and bypass systems in the Project all cause direct mortality. This mortality has a direct effect on the LCR steelhead and UWR chinook populations in the Clackamas River basin.

Habitat Element: Substrate
NOAA Fisheries defines PFC as predominantly gravel and cobble substrate with clear interstitial spaces and >20% embeddedness. The three lower dams of the Clackamas River Project, River Mill, Faraday, and North Fork, all block substrate transport to the lower river. PGE (1996) identified a shortage of spawning gravel in the reach downstream of River Mill Dam. Instream and floodplain aggregate mining have also contributed to this shortage. The Project blocks substrate transport, preventing new spawning gravel recruitment.

Habitat Element: Large Woody Debris
NOAA Fisheries defines PFC as >80 pieces of wood per mile which are >24 inches in diameter and > 50 ft. long. Large woody debris (LWD) incidence and recruitment in the lower river has probably been affected by the clearing of land for agricultural and residential development. The three lower dams of the Clackamas River Project, River Mill, Faraday, and North Fork, all block

LWD transport to the lower river. Large woody debris is rare in the reaches downstream of River Mill Dam.

Habitat Element: Off-Channel Habitat
NOAA Fisheries defines PFC for off-channel habitat as backwaters with cover and low-energy, off-channel areas including ponds and oxbows. Off-channel habitat connectivity in the lower river has been reduced by bank stabilization and diking. Low off-channel habitat frequency downstream of River Mill Dam may be related to shortage of LWD, lack of substrate recruitment, and altered flows from the Clackamas River Project.

Habitat Element: Pool Frequency/Quality
NOAA Fisheries defines PFC for pool frequency based on channel width; the standard for the lower portion of the action area is 18-23 pools/mile. Pool quality for PFC is defined as pools >1 m deep with cover, cool water, and low amounts of fine sediment. Low pool frequency downstream of River Mill Dam may be related to shortage of LWD, lack of substrate recruitment, and altered flows from the Clackamas River Project.

Habitat Element: Refugia
NOAA defines PFC for refugia as being buffered by riparin reserves and of sufficient size, number, and connectivity to maintain a viable population. Low refugia frequency downstream of River Mill Dam may be related to shortage of LWD, lack of substrate recruitment, and altered flows from the Clackamas River Project.

Channel Dynamics: Channel Morphology
NOAA Fisheries defines PFC as a width/depth ratio of <10; streambank condition of > 90% stable; and well-connected, off-channel areas. In the action area, the channel is constrained by roads in a number of areas. Bank protection projects on the lower river constrain the channel and limit flood plain connectivity.

Channel Dynamics: Altered Flows
NOAA Fisheries defines PFC for the watershed hydrograph as being similar in terms of peak flow, base flow, and timing characteristics of the pre-development condition of the action area or an undisturbed watershed of similar size, geography and geology. Pronounced changes to the hydrograph are classified as "Not Properly Functioning."

Oak Grove Project
Flows in the Oak Grove Fork between Timothy Lake and Lake Harriet are also affected by the Eugene Water & Electric Board (EWEB) Stone Creek Project, which diverts flows in the reach between RM 14.9 and RM 9.3. This diversion is reported to have resulted in a reduction of fish habitat in the 5-mi (8-km) bypassed reach (USFS 1996).

The Oregon State hydropower license for the Oak Grove Project (No. 186; Hydroelectric Commission of Oregon 1953) requires that a year-round minimum flow of 10 cfs (0.3 cms) be released downstream of Timothy Lake Dam and limits maximum draft of the reservoir (outflow minus inflow) to 300 cfs (8.5 cms) (Foster-Wheeler Environmental Corporation 1998). The Oak

Grove Fork between Lake Harriet and Timothy Lake supports a coastal cutthroat trout population, which is managed by special angling regulations. Based on the results of an Instream Flow Incremental Methodology (IFIM) study in this reach, the USFS concluded that flows occurring after construction of Timothy Lake were “in the near optimum range in almost all months [for cutthroat trout], indicating that the hydroelectric project improved habitat availability during the winter and spring” (USFS 1996, p. 14).

There are no minimum flow requirements for the reach of the Oak Grove Fork between the Lake Harriet Diversion Dam and the confluence with the mainstem Clackamas River. Except during powerhouse shutdowns and high flow events when the dam spills, Lake Harriet Diversion Dam diverts all flow from the Oak Grove Fork to the diversion pipeline. Streamflow in the 4.3-mi (6.9-km) reach between Lake Harriet Diversion Dam and the confluence with the mainstem Clackamas River is limited to leakage through the dam, groundwater accretion, and tributary inflow. Baseflow during this period averages about 9 cfs (0.3 cms), while the highest recorded peak was almost 1,000 cfs (28 cms). The USFS has concluded that the lack of flow releases from Lake Harriet reduces rearing habitat availability for juvenile spring chinook and coho salmon and winter steelhead and believes that increased instream flows downstream of Lake Harriet Diversion Dam could significantly contribute toward coho salmon production in the Clackamas River watershed upstream of the North Fork Dam (USFS 1996). (Note that the improved rearing habitat could benefit anadromous fish only in the reach downstream of the impassable natural barrier located at RM 3.7, about 1 mi [1.6 km] downstream of Lake Harriet Diversion Dam.)

PGE completed an IFIM analysis that evaluated existing habitat conditions in the Oak Grove Fork downstream of Lake Harriet Diversion Dam and described the relationship between discharge and salmonid habitat in the portion of this reach accessible to anadromous fish (Cascades Environmental Services 1996a). Flows from 4 cfs (0.1 cms) to 215 cfs (6.1 cms) were modeled for the IFIM study. Habitat mapping was completed for the entire reach downstream of the dam (Cascades Environmental Services 1996b). The IFIM study addressed spawning and summer rearing life stages for coho salmon, spring chinook salmon, and steelhead. The analysis considered the drop in flows from spawning flows to rearing flows, and only habitat that maintained at least 1 ft (30.5 cm) of water depth for the entire period of incubation was considered effective for spawning. The Fish and Aquatics Workgroup is currently designing and implementing studies to characterize the effect of Project-altered instream flows on riverine habitat (Appendix B). Part of this analysis may include applying the existing IFIM model to higher flows than have been tested in the past.

Diversion of flows from the Oak Grove Fork also affects flows in the 5-mi (8-km) reach of the mainstem Clackamas River from the Oak Grove confluence (RM 53) to the Oak Grove Powerhouse (RM 48). The effects of flow diversion from the Oak Grove Fork on flow conditions in the Clackamas River mainstem are currently being evaluated by the Fish and Aquatics Workgroup.

North Fork Project

The North Fork Project affects instream flows in the mainstem Clackamas River in the reaches between North Fork Dam and the Faraday Diversion Dam, between the Faraday Diversion Dam and the Faraday Powerhouse, between the Faraday Powerhouse and the head of Estacada Lake, and from the River Mill Dam to the confluence with the Willamette River. There are no minimum flow requirements in the reaches between North Fork Dam and the Faraday Diversion Dam or between the Faraday Powerhouse and the head of Estacada Lake. In the 1.7-mi (2.7-km) reach between the Faraday Diversion Dam and the Faraday Powerhouse, minimum flows of 100 cfs (3 cms) are maintained to provide upstream passage of adult salmonids between Estacada Lake and the Faraday-North Fork fish ladder (ODFW 1992; PGE 1996). Exhibit H-2 of the current FERC license (FERC 1957) for the North Fork Project states that the flows downstream of River Mill Dam are not to be reduced below 300 cfs (8.5 cms).

Resource agencies have expressed concern regarding the minimum flow requirement for adult passage and spawning in the reach between the Faraday Diversion Dam and the Faraday Powerhouse (ODFW 1992). Cramer (1993) evaluated the effects of flow manipulation on stimulating upstream passage in this reach. Increased spill over Faraday Diversion Dam appeared to stimulate passage over North Fork Dam, although results were highly variable. The Fish and Aquatics Workgroup is currently designing and implementing studies to characterize the effect of the Project-altered instream flows on riverine habitat; these studies will include evaluation of the effects of the North Fork, Faraday, and River Mill developments on flow conditions and associated impacts on special status salmonids downstream of River Mill Dam.

Channel Dynamics: Altered Flows - Migration Delays and False Attraction at Powerhouse Discharges

Oak Grove Project

Previous studies have focused on potential migration delays at the Project facilities. Two radio-tracking studies conducted by USFS, ODFW, and PGE provide some information on fish passing the Oak Grove Powerhouse tailrace. From 1988 through 1991, late-run coho salmon migration was evaluated from December through March (Cramer and Merritt 1992). For this study, 84 wild and 14 hatchery-reared adult coho salmon were collected at the trap in the Faraday-North Fork fish ladder, fitted with radio transmitters, and released at the head of North Fork Reservoir (RM 34).

Data from the 1989–1990 phase of the study indicate that 14 (30%) of the 47 salmon tagged migrated as far upstream as the Oak Grove Powerhouse, while 33 (70%) of the tagged salmon remained downstream of the powerhouse. Of the 14 salmon that reached the vicinity of the powerhouse, 9 (64%) halted their migration and/or moved back downstream, and 5 (36%) continued past the powerhouse without apparent delay.

In the 1990–1991 phase of the study, 12 (34%) of the 35 salmon tagged migrated as far upstream as the Oak Grove Powerhouse, while 23 (66%) of the tagged salmon remained downstream of the powerhouse. Of the 12 salmon that reached the vicinity of the powerhouse, 9 (75%) halted their migration and/or moved back downstream, and 3 (25%) continued past the powerhouse without apparent delay. It is unclear whether the powerhouse discharge induced these fish to halt or delay their migration and/or to change direction or whether they were responding to some other behavioral cue.

In the second radio-tracking study, conducted in 1994, 17 wild and 2 hatchery winter steelhead were tracked upstream of North Fork Reservoir (Shibahara and Lumianski 1995). Of the 14 fish that passed the Oak Grove Powerhouse, 1 fish spent two days in the tailrace, while the rest passed the powerhouse in less than one day, indicating that there was little, if any, delay in their migration caused by the Oak Grove Powerhouse operation.

In 1999, a total of 11 early-run coho were captured at the fish trap below the Faraday Diversion Dam. On four different occasions between September 13 and October 1, 9 fish were successfully radio-tagged (Shibahara 2000b). All fish were released at the boundary boat ramp in North Fork Reservoir. Within 6 to 15 days, all fish had passed the Oak Grove Powerhouse and moved on to the upper Clackamas River basin. Of the 9 fish, 6 required less than 7 days to travel the distance from the release point to past the powerhouse, 2 fish required 8–9 days, and 1 fish required 15 days. The results from this study indicate that coho salmon did not hold within the Oak Grove Powerhouse tailrace during upstream migration.

Recent results indicate that some delays may occur at the Oak Grove Powerhouse. Results from the 2000 coho radiotelemetry study indicate that there is no significant delay at the Oak Grove Powerhouse (Shibahara et al. 2001). Remote data logger sites indicate that fish spent an average of 0.3 days and a maximum of 4 days at the Oak Grove Powerhouse.

North Fork Project

The Faraday Powerhouse discharges water diverted at the Faraday Diversion Dam back into the mainstem Clackamas River. Because flow in the diverted reach is typically limited to 100 cfs (2.8 cms), discharge from the powerhouse (which can be more than 2,000 cfs [56.6 cms]) may exceed flows in the mainstem channel immediately upstream of the powerhouse (Turner 1998b). Some delay in migration may occur in summer, when fish are attracted to the cooler water and higher flows exiting the Faraday Powerhouse (ODFW 1992). Gunsolus and Eicher (1970) evaluated false attraction and delays to migration caused by the Faraday Powerhouse discharge as part of the initial Faraday-North Fork fish ladder evaluation. Although they observed adult spring chinook salmon congregating at the Faraday Powerhouse, they concluded that the powerhouse tailrace did not impede adult migration. Shibahara (2000a) concluded that 3 out of 4 radio-tracked steelhead did not experience delay at the Faraday Powerhouse or fish ladder. In a study of 36 radio-tagged early-run coho salmon, however, Shibahara (2000b) found that the tagged fish spent an average of 21 hours in the Faraday Powerhouse tailrace, and 10 of the fish spent more than 24 hours there, indicating a likely delay.

Channel Dynamics: Altered Flows - High Flows

Oak Grove Project

The effects of the Clackamas River Project on peak flows were evaluated by comparing flow records at the USGS gage on the Oak Grove Fork 1 mi (1.6 km) upstream of Harriet Diversion

Dam (USGS gage number 14209000), before and after the construction of Timothy Lake Dam. The pre-dam period of record used for the analysis was January 1921-September 1955. The post-dam period of record used was January 1957-December 1996 (PGE 2000a). This analysis found that annual peak flows changed little following construction of Timothy Lake Dam. For example, the 100-year peak flow was about 5,252 and 5,316 cfs (148 and 150 cms) prior to and following the construction of Timothy Lake Dam, respectively. The timing of peak flows has changed somewhat, with fewer annual peaks in the spring (when the reservoir is filling) since the construction of Timothy Lake Dam. Because of incomplete or poor records at other gages, the analysis did not compare pre- and post-dam peak flows elsewhere (PGE 2000a).

In addition, peak flow analyses that compare records of different time periods may reflect differences in climate rather than hydrologic alterations caused by the Project. The effects of the North Fork Project on peak flows have not been determined, but will be evaluated as part of the relicensing process. Given the limited storage capacity in the North Fork Project, effects on peak flows are expected to be minimal. The total storage capacity of the North Fork Project reservoirs is about 5% of the pre-dam median annual water yield at River Mill (1914–1928) (147,000 acre-feet [18,132.3 ha-m]).

Channel Dynamics: Altered Flows - Flow Fluctuations

Flow fluctuations can result in stranding or entrapment of juvenile and adult salmon in de-watered or isolated areas as flows recede (during downramping). Stranding occurs when fish are trapped in dewatered areas and die of asphyxiation or desiccation. Entrapment occurs when fish are isolated in potholes or side channels that become separated from the flowing channel. These entrapped fish may subsequently become stranded if flows continue to recede. They may also be subject to increased predation and physiological stress (caused by high temperatures and oxygen deficit). If flows increase and inundate the side channel or pothole, the entrapped fish may return to the main channel (R.W. Beck and Associates 1987). Stranding and entrapment of salmon have been documented on many rivers in the Pacific Northwest (Phinney 1974; Bauersfeld 1978; Becker et al. 1981; Woodin et al. 1984; and R.W. Beck and Associates 1987). Flow fluctuations during spawning seasons can also result in dewatering of redds.

The effects of flow fluctuations on salmonids depends on the rate and magnitude of fluctuations, the morphology of channels and floodplains, and the timing of the fluctuations relative to salmonid life cycles. The Fish and Aquatics Workgroup is currently designing and implementing studies to characterize the effects of Project upramping and downramping on riverine habitat (PGE 2001b).

<u>Oak Grove Project</u>

Operation of the Oak Grove Project can result in flow fluctuations in the Oak Grove Fork between Timothy Lake and Lake Harriet and in the mainstem Clackamas River downstream of the Oak Grove Powerhouse. Under normal conditions, flow fluctuations between Timothy Lake Dam and Lake Harriet caused by Project operations are not to exceed 4 inches per hour. In 1998, the Oak Grove Powerhouse began operating as a peaking facility. This has resulted in increased frequency and magnitude of fluctuations in the mainstem Clackamas River downstream of the powerhouse to North Fork Reservoir. During peaking operations, using Frog

Lake storage, flows are generally increased between 6 a.m. and 10 a.m., held at natural flows from 10 a.m. to 6 p.m., increased from 6 p.m. to 10 p.m., and reduced from 10 p.m. to 6 a.m.

Comparison of flow fluctuations indicates that flow fluctuation has a proportionally greater effect on flow in the mainstem during summer and fall (when flows in the mainstem are low) and a lesser effect on flows in the mainstem during winter months (when flows in the mainstem are higher). In 1998, flow fluctuations in the mainstem Clackamas River associated with power peaking operations occurred in all months except January and typically altered flow conditions by about 500 cfs (14 cms). The magnitude of these flow fluctuations relative to the instream flow was least in February and March and greatest in July and August.

Daily maximum fluctuations are much higher at the Oak Grove Powerhouse than at Timothy Lake. A 1998 duration curve of the difference between daily minimum and maximum flows for Timothy Lake and the Oak Grove Powerhouse shows that the median fluctuation for 1998 was about 5 cfs/day (0.1 cms/day) at Timothy Lake and 288 cfs/day (8.2 cms/day) at the Oak Grove Powerhouse (PGE 2000b). The Fish and Aquatics Workgroup is currently designing and implementing studies to characterize the effects of Project upramping and downramping on riverine habitat (Appendix B).

North Fork Project

Operation of the North Fork Project can result in flow fluctuations in the mainstem Clackamas River downstream of the Faraday Powerhouse and downstream of River Mill Dam. Downstream of the Faraday Powerhouse, flow fluctuations are not restricted. These unrestricted fluctuations, however, affect only a short reach (about 0.25 mile [0.40 km]) between the powerhouse and the head of Estacada Lake.

Currently, PGE tries to minimize flow fluctuations downstream of River Mill Dam, and the dam is used as a peaking facility only when excessive power demands make peaking necessary. Peaking, however, does occur at River Mill Dam. Hydrographs show flow fluctuations for February 1998 (representative of fluctuation conditions for winter), April 1998 (representative of fluctuation conditions for spring), and July 1998 (representative of fluctuation conditions for summer). The daily maximum rate of downramping during 1998 was frequently 180 cfs/hour (5 cms/hour), with a maximum of about 1,200 cfs/hour (34 cms/hour) (PGE 2000b).

Comparison of flow fluctuations from hourly River Mill Powerhouse discharges and flow in the mainstem Clackamas River at the USGS gage below River Mill indicates that flow fluctuation has a proportionally greater effect on flow in the mainstem during summer and fall (when flows in the mainstem are low) and lesser effect on flows in the mainstem during winter months (when flows in the mainstem are higher). The median daily flow fluctuation was about 700 cfs/day (20 cms/day) at the River Mill Powerhouse in 1998 (PGE 2000b). The Fish and Aquatics Workgroup is currently designing and implementing studies to characterize the effects of Project upramping and downramping on riverine habitat (PGE 2001b).

Channel Dynamics: Altered Flows - Seasonal Flow Patterns

Oak Grove Project

Flows in the Oak Grove Fork between Timothy Lake and Lake Harriet are reduced compared with natural levels during the spring snowmelt period through June 1. From June 1 through the beginning of September, Timothy Lake is operated in run-of-the-river mode and does not affect seasonal flow patterns in the reach above Lake Harriet. Flows are increased above normal for several weeks during the fall drawdown period beginning in September. Since 1956, mean monthly flow is lower in April through August and higher in September through March, relative to pre-1956 records. The increase in mean monthly flows relative to pre-dam conditions is generally less than 100 cfs (3 cms), which is less than 20% of flow, while spring flows have been decreased by up to about 180 cfs (3 cms) in May (about 30% of pre-dam flow).

Downstream of the Lake Harriet Diversion Dam, flows are reduced throughout the year by the Oak Grove Project. The Lake Harriet Diversion Dam spills only when flows exceed the 660-cfs (18.7-cms) diversion capacity and during powerhouse shutdowns. Between 1994 and 1999, daily average flow at the USGS gage above Lake Harriet exceeded the diversion capacity of 660 cfs (18.7 cms) 24% of the time. Over that same period, spills due to Oak Grove Powerhouse shutdowns for maintenance occurred 19 times (PGE 2000b). The powerhouse was shut down for a total of 504.3 hrs, 86% of which occurred during an 18-day shutdown that released 230 cfs (6.5 cms) into the diversion reach in October 1995 (PGE 2000b). The 1.5-year flood downstream of Lake Harriet has been reduced from 1,330 cfs (37.6 cms) to 607 cfs (17.2 cms) by the diversion (PGE 2001a).

The Oak Grove Project may affect the quantity and quality of spawning habitat in the accessible portion of the Oak Grove Fork, and the reach of the Clackamas River between the mouth of the Oak Grove Fork and the Oak Grove Powerhouse. Downstream of the powerhouse there is a risk of dewatering of redds due to ramping operations.

North Fork Project

Seasonal flow patterns in the 1.7-mi (2.7-km) reach between the Faraday Diversion Dam and the head of Estacada Lake and in the 23-mi (37-km) reach downstream of River Mill Dam are altered by operations of the North Fork Project. Changes in seasonal flow patterns resulting from the North Fork Dam operations have the potential to affect anadromous salmonids downstream of the Project. Spring and fall chinook, coho, steelhead, and cutthroat trout spawn and rear in, and outmigrate through, the reach below River Mill Dam. The Fish and Aquatics Workgroup is currently designing and implementing studies to characterize the effect of the Project on instream flows (PGE 2001b).

In the upper basin, above North Fork Dam, there is a likely degradation of loss of habitat associated with reduced flows described in this section. Additionally, ramping operations described in this section pose a risk of stranding for juveniles. Since downstream migrating juvenile counts are far below the estimated carrying capacity of the upper basin, rearing habitat is probably not a limiting factor at this time. However, any improvements in productivity, in this case juvenile survival, would make a positive effect towards population recovery.

Spawning also occurs downstream of North Fork Dam. In the case of LCR fall chinook, all spawning occurs downstream of River Mill Dam. Spring chinook also spawn in the bypassed reach between the Faraday Diversion Dam and the powerhouse. Spawning areas downstream of North Fork Dam suffer the effects of increased water temperature and blocked sediment transport associated with the three lower dams. These effects result in degraded spawning habitat with a likely loss of productivity for the populations that spawn in these areas. The population most critically affected by the degraded spawning habitat conditions, since all of its spawning occurs in this area, is LCR chinook.

Watershed Condition: Increase in Drainage Network
NOAA Fisheries defines PFC as zero to medium increases in drainage network due to roads. That is, construction of roads and their companion drainage systems has not increased the total number of drainage routes to the river (potentially increasing input of sediment and contaminants). Extensive agricultural development of lower watershed has resulted in an increase in the drainage network. Increases in drainage networks associated with the Clackamas River Project have probably been small.

Watershed Condition: Road Density and Location
NOAA Fisheries defines PFC as <2 mi of road per square mile with no valley bottom roads. The lower Clackamas River basin has extensive road networks associated with agricultural and urban development. Highway 224 parallels the river for a number of miles. There is also a relatively high density of unpaved roads in the upper watershed. The Clackamas River Project includes a number of roads, some with culverts that block migration; however, the majority of roads in the drainage are logging roads or State and County roads.

Disturbance History: Riparian Reserves
NOAA Fisheries defines PFC as a riparian reserve system which provides adequate shade, LWD recruitment, habitat protection, and connectivity to all subwatersheds. This reserve must be >80% intact and the vegetation must be >50% similar to the potential natural community composition. Riparian reserves in the lower basin are limited primarily to deciduous trees along the riverbanks. Most of the lower basin has been cleared for agricultural and urban development. The Clackamas River Project has had a relatively small effect on loss of riparian reserves in the Clackamas River basin.

Channel Dynamics: Channel Morphology
The channel is constrained by roads in a number of areas. Bank protection projects on the lower river constrain the channel and limit floodplain connectivity.

2.1.1.4.4 Summary of Environmental Baseline

The habitat biological requirements of the Clackamas fall-run chinook population of the LCR chinook ESU, the Clackamas spring-run chinook population of the UWR chinook ESU, and the Clackamas winter-run steelhead population of the UWR steelhead ESU are not being met under the environmental baseline. Environmental baseline conditions in the action area would have to improve to meet those biological requirements not presently met. Any further degradation or delay in improving these conditions might increase the amount of risk the listed ESUs presently face under the environmental baseline. Table 4 displays a summary of the relevant factors discussed in Section 2.1.1.4, based on the Matrix of Pathways and Indicators described in NMFS (1996).

Table 4. Matrix of Pathways and Indicators for the environmental baseline. Unless otherwise noted, the descriptions apply to the habitat biological requirements of the populations of all three listed ESUs found in the action area. Function codes: PF: properly functioning, NPF: Not properly functioning, AR: At Risk

Path way	Indicator	Function	Description	Source
Water Quality	Temperature	NPF	From River Mill Dam tailrace to river mouth listed on 303(d) list for high temperature. High rate of warming in North Fork Reservoir	North Fork, Faraday and River Mill dams and reservoirs
	Sediment/ Turbidity	PF		
	Contamination	NPF	RM 0-15 listed on Oregon 303(d) list for exceeding fecal coliform standards. Potential for mercury bioaccumulation in North Fork Reservoir	Domestic or agricultural sources?
Habitat	Barriers	NPF	Three dams in main migration corridor, one with poorly functioning fish ladder Downstream passage largely through turbines	River Mill, Faraday and North Fork dams
Habitat Elements	Substrate	NPF	Substrate transport blocked by three mainstem dams. Downstream of River Mill Dam with spawning gravel shortage	River Mill, Faraday and North Fork dams
	Large Woody Debris	NPF	LWD transport blocked by three mainstem dams, recruitment impacted by loss of riparian vegetation associated with logging, residential, and agricultural development.	River Mill, Faraday and North Fork dams Logging, residential, and agricultural development

Function codes: PF: properly functioning, NPF:Not properly functioning AR: At Risk

Pathway	Indicator	Function	Description	Source
Habitat Elements	Pool Frequency/Quality	NPF	Pools rare in lower river	Diking and streambank development in lower river Altered flows from Project operations
	Off-Channel Habitat	AR	Limited in lower river	Diking and streambank development in lower river Altered flows from Project operations
	Refugia	AR	Rare in river downstream of River Mill Dam	Diking and streambank development in lower river Altered flows from Project operations
Channel Dynamics	Channel Morphology	AR	Channel constrained by road through much of watershed	State and County roads
	Streambank Condition	AR	Agricultural/residential development of lower river	Agricultural and urban development
	Flood plain Connectivity	AR	Agricultural/residential development of lower river	Agricultural and urban development Altered flows from Project operations

Function codes: PF: properly functioning, NPF:Not properly functioning AR: At Risk

Pathway	Indicator	Function	Description	Source
Channel Dynamics	Altered Flows	NPF	Altered flow patterns affect migration False attraction flows at Oak Grove Powerhouse and Faraday Powerhouse Possible ramping effects downstream of Oak Grove PH	Project operations EWEB project operations
Watershed Conditions	Increase in Drainage Network	NPF	Significant increase due to extensive road network and agricultural development	State and County roads Agricultural and urban development
	Road Density and Location	NPF	Extensive road network in lower watershed Some access problems due to roads and culverts in upper watershed	State and County roads Logging roads
	Disturbance History	AR	Lower basin mostly cleared for agriculture and residential development	Logging, agricultural and urban development
	Riparian Reserves	NPF	Good riparian reserves in upper watershed Alders and other deciduous trees dominate lower watershed riparian zone	Logging, agricultural and urban development

Function codes: PF: properly functioning, NPF:Not properly functioning AR: At Risk

2.1.1.4.5 Ecological Factors Affecting Clackamas River Basin Salmonids

Competition/Predation/Hybridization with Introduced Fish Species

Introduced salmonid species include brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), kokanee (*Oncorhynchus nerka*), and hatchery rainbow and cutthroat trout. Until 1998, fish managers planted hatchery rainbow trout in the Clackamas River up to RM 70. Because of concerns about potential impacts of hatchery rainbow trout on wild steelhead, stocking of hatchery trout in running waters of the Clackamas River basin has been discontinued (PGE 1999). Hatchery rainbow trout stocking programs continue in lakes within the basin, including annual plantings of about 169,000 catchable-sized fish within the basin. A significant number of hatchery trout are stocked into the North Fork Project reservoirs, including North Fork Reservoir, Faraday Lake, and Estacada Lake. About 10,000 hatchery rainbow trout are released each year in Estacada and Faraday lakes. Large numbers of catchable rainbow trout are also released annually in Timothy Lake and Lake Harriet (PGE 1999). Spruell et al. (1998) found that a high proportion of trout in the upper Oak Grove Fork were cutthroat/rainbow trout hybrids, but did not provide specific locations of sampling.

Hatchery summer steelhead are also released into the Clackamas River basin. Some natural production of this summer hatchery stock is assumed to occur, and competition with non-native summer steelhead is considered to be a major factor affecting the native winter steelhead population. Chilcote (1998) concluded that the introduction of non-native summer steelhead to the Clackamas River basin likely reduced winter steelhead productive capacity and resulted in a 27% decrease in the population's resiliency. Fin-clipped summer steelhead have been excluded from passage above the North Fork Dam since 1999.

Kokanee (landlocked sockeye salmon) were originally introduced into Timothy Lake after construction of Timothy Lake Dam. Kokanee stocking continued until the 1960s. Today, the reservoir supports a large population of naturally reproducing kokanee.

Brown trout plantings began in the Clackamas River basin around the turn of the century and were discontinued around 1939 (PGE 1999). Presently, brown trout reproduce naturally in tributaries to Lake Harriet and Round Lake.

A number of warm-water game fish species have also been introduced into the Clackamas River basin. Although no extensive or ongoing hatchery programs have been associated with these species in the Clackamas River, their presence in the basin is in many cases the result of deliberate introductions. Warm-water fish species may prey on and compete with native salmonids, especially where habitat has been degraded and water temperatures are higher.

2.1.2 Analysis of Effects of the Proposed Action

2.1.2.1 Effects of Proposed Action

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR §402.02). Direct effects occur at the Project site and may extend upstream or downstream based on the potential for impairing important habitat elements. Indirect effects are defined in 50 CFR §402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification" (50 CFR §403.02). "Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

2.1.2.1.1 Methods of Analysis

In step 3 of NOAA Fisheries' jeopardy approach, it evaluates the effects of proposed actions on listed salmon and steelhead in the context of whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action. The action also must restore, maintain, or at least not appreciably interfere with, the recovery of the PFCs of the various fish habitat elements within a watershed.

NOAA Fisheries may use either or both of two independent techniques in determining whether the proposed action jeopardizes a species continued existence. First, NOAA Fisheries may consider the impact in terms of how many listed salmon will be killed or injured during a particular life stage and then gauge the effects of that take on population size and viability. Alternatively, NOAA Fisheries may consider the effect on the species freshwater habitat requirements, such as water temperature, streamflow, etc. The habitat analysis is based on the well-documented cause and effect relationships between habitat quality and population viability. While the habitat approach to the jeopardy analysis does not quantify the number of fish adversely affected by habitat alteration, it considers this connection between habitat and fish populations by evaluating existing habitat condition in light of habitat conditions and functions known to be conducive to salmon conservation (Spence et al. 1996). In other words, it analyzes the effect of the action on habitat functions that are important to meet salmonid life cycle needs. The habitat approach then links any failure to provide habitat function to an effect on the population and to the ESU as a whole. For this consultation, NOAA Fisheries utilizes the habitat approach in considering the biological requirements best described by important habitat characteristics.

2.1.2.1.2 Direct Effects of the Project

Direct effects are the direct or immediate effects of the Project on the species or its habitat. Direct effects result from agency action, including the effects of interrelated actions and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not considered in this BO.

Effects of Continued Operations

The direct, indirect, and cumulative effects of Project operations on listed, proposed, and candidate species and on their designated critical habitat are described under baseline conditions in the BE (PGE 2001b). Continued operation of the Project would result in continuation of the baseline condition until the issuance of a new FERC license.

River Mill Fish Ladder Replacement and Spillway Modification and Bypass Pipe Improvement

Improving passage of adult spring chinook salmon over this ladder has been identified as an objective of ODFW's Clackamas River Subbasin Fish Management Plan (ODFW 1992). The ladder was constructed at the same time as the River Mill Dam, 1912, and does not meet current passage design standards; it is too steep and the pools are too small to effectively dissipate flow energy. Congregations of fish observed below the dam and the current failure of LCR fall chinook to migrate upstream of River Mill Dam (as they did historically), indicate migration delay and/or non-passage of anadromous fish. Listed salmonid stocks will continue to be subject to migration delays at the River Mill fish ladder through 2005.

The River Mill Dam spillway opens onto a jagged rock outcrop which causes high mortalities among juvenile salmonids and steelhead kelts passing over the spillway. The only other routes of downstream passage past River Mill Dam include a bypass of unknown efficiency and passage through the turbines. The proposed modification will extend a concrete shelf over the rock outcrop and include a channel for juvenile transport during periods of limited spills. However, according to the schedule described in the BE, construction on the spillway modification will not be conducted until 2004 (PGE 2001b). As a result, downstream migrating fish will continue to be subjected to high mortalities associated with passage over River Mill spillway for at least two years of the four-year period covered by this BO.

The current Faraday-North Fork fish ladder and bypass outlet pipe is about 20 ft (6.1m) above the water surface. Juveniles and kelts migrating downstream through the bypass are subject to injury from this fall. According to the schedule described in the BE, the pipe will be relocated in 2003 (PGE 2001b). Until the outfall pipe is relocated, downstream migrating fish will continue to be subject to mortality from fall associated with the excessive height of the bypass outfall.

The proposed construction schedule for modifications to River Mill Dam passage facilities stretches over three years. The schedule includes activities which may have a direct effect on streambanks and water quality including sedimentation, release of fuel or other toxic substances from vehicles, and disturbance of fish behavior from construction activities above and around the water. Existing passage structures will also have to be demolished and a new fish ladder built, leaving a period when there is no functioning fish passage at River Mill Dam.

Measures are included in the proposed action to minimize potential negative impacts of construction activities (PGE 2001b). The construction procedure for the new ladder will allow the existing facility to be used until the late stages of the construction. Decommissioning of the existing ladder, and the resulting blockage of any adult fish passage over the River Mill Dam, will only take place when ODFW and NOAA Fisheries agree that this action is not detrimental to a significant segment of the migrating salmon and steelhead populations. If NOAA Fisheries and ODFW determine that additional efforts are needed, trap and haul operations will be used temporarily during construction to minimize impacts to migrating salmon.

It appears that sufficient measures have been taken to protect listed salmonid populations during construction activities. Although it seems likely that upstream fish passage will be impeded during the final stages of construction, it is not possible to predict the effects of these modifications on fish passage at River Mill Dam.

Faraday Unit 6 Runner Replacement

There are no indications that the runner replacement will adversely affect listed Clackamas salmonid populations. The structure will be isolated from the Clackamas River during work and the only apparent potential adverse impact is the release of oil or other contaminants into the river during or after the replacement operation.

Operational Changes Resulting from North Fork Unit 2 Turbine Upgrade

Operations at the North Fork Powerhouse will change somewhat from the past, when the units had identical efficiency characteristics and were operated equally and interchangeably. When the upgraded Unit 2 turbine is operating above 27 MW, the flows into and through the unit will be higher than in the past. This means the water currents near the intake will also be higher than they were before upgrade of the unit. Changes in water velocity patterns associated with these operational changes may change the efficiency of the bypass surface collector. Reductions in surface collector efficiency would result in more juvenile salmonids passing through the turbines, a passage route associated with higher mortality than the juvenile bypass.

Implement a Gravel Augmentation Pilot Project Downstream of River Mill Dam

As described in Section 2.1.1.4.3 , the dams within the North Fork Project likely intercept coarse sediment from most of the Clackamas River watershed, reducing the supply of coarse sediment to the river downstream of the Project. If successful, gravel augmentation could improve spawning habitat downstream of River Mill Dam.

Manage Spills in the North Fork Project to Reduce Entrainment in Faraday Powerhouse

The intent of this measure is to prevent entrainment of fish that pass over the North Fork Dam spillway into the Faraday Powerhouse turbines. The North Fork Dam spillway is partially screened to protect juvenile downstream migrants. Spilled flows up to 500 cfs pass through a screen that diverts juveniles to the juvenile bypass facility. Spilled flows exceeding 500 cfs are not screened. For example, if 1,000 cfs is spilling, 500 cfs is screened and 500 cfs is not screened. Significant numbers of juvenile spring chinook salmon, coho salmon, and steelhead may pass over the North Fork spillway during winter and spring spills. After exiting North Fork Reservoir via the North Fork Dam spillway, juvenile salmonids must pass downstream either via the Faraday Diversion Dam spillway or the Faraday Powerhouse turbines. This measure is intended to reduce take by reducing entrainment of juvenile salmonids in the Faraday Powerhouse turbines following spill events at North Fork Dam. The anticipated benefits of this measure have not been quantified and are based on the following assumptions:

- Juvenile winter steelhead and coho salmon pass the mainstem Project developments primarily from April through June, and juvenile spring chinook salmon pass these developments primarily from April through June and in November.
- Juveniles will reach Faraday Diversion Dam within two days following spill at North Fork Dam.
- Juveniles reaching Lake Estacada can successfully pass River Mill Dam via the downstream migrant facility or the spillway (once it is reconstructed).

The proposed spill management window targets the period when about 70% of spring chinook salmon, 93% of coho salmon, and 100% of steelhead would be passing downstream, based on the capture of juvenile salmonids in the North Fork juvenile bypass. The actual benefits of this measure will be hard to quantify. Improved survival from this measure is strongly dependent on proper functioning of the surface collector and bypass system at North Fork Dam.

Provide Increased Operating Flows Downstream of River Mill Dam
Operation of the North Fork Project affects instream flows in the mainstem Clackamas River from River Mill Dam to the confluence with the Willamette River. This reduction in streamflow could potentially affect spawning, incubation, and rearing conditions for fall chinook salmon, winter steelhead, and cutthroat trout; rearing conditions for spring chinook salmon; and outmigration conditions for spring and fall chinook salmon, steelhead, coho salmon, and anadromous cutthroat trout. The effects of current flow conditions on salmonid habitats and outmigration conditions downstream of River Mill Dam have not been assessed, but will be evaluated during relicensing. The proposed operating flows are higher than flows required under the current FERC license. The proposed operating flows are lower than recorded mean monthly flows downstream of the dam (for the period 1959–1995) for October through June and are about equal to recorded mean monthly flows for July through September. The implementation of a flow regime that more closely resembles the pre-Project hydrograph seems likely to have positive effects on the physical and biological environment of the Clackamas River, although it is unlikely that the proposed flows will be sufficient to offset all of the negative effects of Project operation.

Acquire Spawning and Rearing Habitat for Salmon and Steelhead in the Clackamas River Basin
The objective of this measure is to provide permanent protection to sensitive habitat along current or historic salmonid and steelhead spawning and rearing. The effects of acquisitions of land and water will depend on the location of the property, its current or historic significance as a spawning or rearing area, and, if needed, whether active restoration is implemented. Instream work would have the temporary effects of sediment disturbance, but this can be managed through implementation of best practices.

Remediation of Culverts and Road Crossings

It was noted in the BE that most of the Applicant's Project roads are above the upstream limits of anadromous salmonid distribution (PGE 2001b). Thus, culvert remediation is unlikely to have a large direct effect on listed salmonids. There are possible indirect benefits from reduced sediment loading and improvements of other water quality degradation associated with road crossings. However, culvert replacement and road crossing remediation also propose short-term risks associated with work in and over the water (e.g., sedimentation, release of fuel, disturbance, etc.). If proper work measures, such as those described for the fish ladder replacement and spillway modification, are followed, these risks should be minimized.

Effects of Proposed Studies

The effects of continued Project operations over the term of this BO include a number of continuing adverse effects to listed Clackamas River salmonids. However, there still exists a large degree of uncertainty as to the most effective way to address these adverse effects. Given current population status and trends, it is unlikely that the continuing adverse effects will cause the extinction of listed Clackamas salmonid populations within the relatively short (i.e., 3- year) term of this BO. However, these same adverse effects pose a serious risk of extinction to listed Clackamas salmonids over the 20- to 50-year term of the license that is likely to be granted in 2006. Studies specifically addressing critical uncertainties are described in Table 2. By conducting studies during the interim period covered by this BO, NOAA Fisheries and FERC will be able to more effectively address reduction or elimination of adverse effects in the license to be granted to the Project in 2006.

Table 5. Analysis of Project effects. Summary of effects of proposed action on Clackamas River listed salmonids. IMPAIR = impair properly functioning habitat; REDUCE = appreciably reduce the functioning of already impaired habitat; RETARD = retard the long-term progress of impaired habitat towards properly functioning condition; NR = not reduce, retard, or impair; NPF = baseline not properly functioning; AR = baseline at risk; PFC = baseline properly functioning conditioning. UWRC=Upper Willamette River Chinook, UWRS= Upper Willamette River Steelhead, LCC= Lower Columbia Chinook, FCM = Fisheries Conservation Measure.

Project Feature	**Effects**	**ESU**	**Life Stage**	**Effect Pathway/ Indicator**	**Baseline Status**	Effect of proposed action	Proposed Studies addressing effect
Timothy Lake and Dam	Altered patterns of peak flows	All	All	Altered Flows	NPF	Reduce/ Retard	1,2,5,6
Lake Harriet Diversion	Reduced baseflows in the Oak Grove Fork below Lake Harriet Diversion Dam and reduced baseflows in Clackamas River diversion reach (confluence of OG Fork to OGPH)	UWRC UWRS	adult (holding and spawning) egg incubation, juvenile (rearing)	Altered Flows	NPF	Reduce	4,6
Lake Harriet Diversion	Reduced flows downstream of the dam result in increased water temperature in the lower OG fork, as well as the mainstem Clackamas during summer/fall baseflows	UWRC UWRS	adult (holding and spawning) egg incubation, juvenile (rearing)	Temperature	NPF	Reduce	32,34
Lake Harriet Diversion	Loss of sediment and LWD recruitment	UWRC UWRS	adult (holding and spawning) egg incubation, juvenile (rearing)	Substrate LWD	NPF	Reduce/ Retard	1,4,6
Lake Harriet Diversion	Off-channel habitats lost due to reduced flows	UWRC UWRS	adult (holding and spawning) egg incubation, juvenile (rearing)	Off Channel Habitat	NPF	Reduce	1, 4, 6

Project Feature	**Effects**	**ESU**	**Life Stage**	**Effect Pathway/ Indicator**	**Baseline Status**	Effect of proposed action	Proposed Studies addressing effect
Oak Grove Fork Diversion	Effects of OG Fork diversion on flood plain and riparian habitat, sediment budget, LWD and channel morphology in OG and mainstem Clackamas	UWRC UWRS	adult (holding and spawning) egg incubation, juvenile (rearing)	Habitat Elements Channel Dynamics	NPF	Retard	1, 4, 6
Oak Grove Fork Diversion	Routing of flows through the diversion system increases temperature of water released from the powerhouse	UWRC UWRS	juvenile (rearing) adult (migration)	Temperature	NPF	Reduce	32, 3 6
Oak Grove Powerhouse	Delay of adult upstream migration and false attraction. Injury of adults by draft tube strike	UWRC UWRS	juvenile (rearing)	Barrier	NPF	Impair	
Oak Grove Powerhouse	Off-channel/lateral habitats may be affected by ramping.	UWRC UWRS	egg incubation, juvenile (rearing) adult (spawning)	Off-Channel Habitat	NPF	Reduce	2
Oak Grove Powerhouse	Ramping (stranding, entrapment), repeated ramping may force juveniles into suboptimal habitat or early outmigration)	UWRC UWRS	juvenile (rearing)	Altered Flows	NPF	Impair	2
North Fork Reservoir	Affects of NF reservoir on temperature and other WQ dynamics and increased water temperature in fish ladder	UWRC UWRS	juvenile (migration) adult (migration)	Temperature	NPF	Reduce	32, 34
North Fork Spillway	Injury or mortality of outmigrants passing over spillway during high flows Places outmigrants in reach where they may be subject to entrainment at Faraday Powerhouse and, subsequently River Mill PH	UWRC UWRS	juvenile (outmigration)	Barrier	NPF	Impair	11, 14, 16, 18, 20, 23

Project Feature	**Effects**	**ESU**	**Life Stage**	**Effect Pathway/ Indicator**	**Baseline Status**	Effect of proposed action	Proposed Studies addressing effect
Faraday-North Fork Juvenile Bypass	potential for injury, mortality, or delay; outfall exceeds impact velocity criteria	UWRC UWRS	juvenile (outmigration) kelts (outmigration)	Barrier	NPF	Impair	11, 14, 16, 18, 20, 23
Faraday-North Fork Juvenile Bypass	FCM: Relocate juvenile outfall as part of River Mill spillway and fish ladder reconstruction project	UWRC UWRS	juvenile (outmigration) kelts (outmigration	Barrier	NPF	NR	
North Fork Dam and Powerhouse	Reservoir retention and reduced flows result in increased temperature downstream of the dam.	UWRC UWRS	egg incubation, juvenile (rearing) adult (migration and spawning)	Temperature	NPF	Impair	32, 34
North Fork Dam and Powerhouse	Entrainment into turbines	UWRC UWRS	juvenile (rearing and outmigration) Kelts	Barrier	NPF	Impair	12, 13, 14, 23,
North Fork Dam and Powerhouse	May delay/block smolt outmigration	UWRC UWRS	juvenile (outmigration)	Barrier	NPF	Reduce	12
North Fork Dam and Powerhouse	May delay/block upstream adult salmonid migration and downstream (Kelt) migration.	UWRC UWRS	Adult (upstream migration)	Barrier	NPF	Reduce	13, 30
North Fork Dam and Powerhouse	Blocks recruitment of sediment and LWD	All	All	Sediment	NPF	Retard	5
North Fork Dam and Powerhouse	Reduced base and peak flows	All	All	Altered Flows Channel Morphology	NPF	Reduce	

Project Feature	**Effects**	**ESU**	**Life Stage**	**Effect Pathway/ Indicator**	**Baseline Status**	Effect of proposed action	Proposed Studies addressing effect
North Fork Dam and Powerhouse	Ramping results in stranding of juveniles or entrapment of juveniles or adult salmonids	UWRC UWRS	Juvenile Adult	Altered Flows	NPF	Reduce	2
Modified Operation of NF Powerhouse unit 2	None apparent					NR	
Faraday Lake	Increased temperatures and nutrient loading	All	juvenile (rearing and outmigration)	Water Quality	NPF	Reduce	32, 34
Faraday Diversion Dam, Spillway, and Powerhouse	Entrainment into turbines	UWRC UWRS	juvenile (rearing and outmigration) Kelts	Barrier	NPF	Reduce	18
Faraday Diversion Dam, Spillway and Powerhouse	Blocks upstream migration and access to reach between North Fork Dam and Faraday Diversion Dam and above and downstream (kelt) migration.	UWRC UWRS	Adults (upstream migration)	Barrier	NPF	Reduce	
Faraday Diversion Dam, Spillway and Powerhouse	FCM:Improve passage and reduce handling at Faraday-North Fork fish trap.	UWRC UWRS	Adults (upstream migration)	Barrier	NPF	NR	
Faraday Diversion Dam, Spillway and Powerhouse	FCM:Reduce juvenile and kelt entrainment in Faraday powerhouse	UWRC UWRS	Adults (upstream migration)	Barrier	NPF	NR	
Faraday Diversion Dam, Spillway and Powerhouse	Reduced/altered flow patterns	All	All	Altered flows	NPF	Reduce	5, 26

Project Feature	Effects	ESU	Life Stage	Effect Pathway/ Indicator	Baseline Status	Effect of proposed action	Proposed Studies addressing effect
Faraday Unit 6 Runner Replacement	No apparent effect			No Effect		NR	
Estacada Lake	Increased temperatures and nutrient loading	All	All	Temperature	NPF	Reduce	32, 34
River Mill Dam and Powerhouse	Dam may delay adult upstream and downstream (Kelt) migration.	All	Adult migration	Barrier	NPF	Reduce	9, 30, 31, 19
Rebuild River Mill Fish Ladder	FCM: Improve fish passage above River Mill Dam	All	Adult migration	Barrier		NR	
Rebuild River Mill Fish Ladder - construction activities	Potential temporary sediment above background levels Potential temporary release of contaminants	All	All	Water Quality		NR	
River Mill Dam and Powerhouse	Entrainment into turbines	UWRC UWRS	Juveniles Kelts	Barrier	NPF	Reduce	17
River Mill Dam and Powerhouse	Blocks recruitment of sediment and LWD, Effects flood plain and riparian habitat, sediment budget, LWD and channel morphology below River Mill Dam	All	All	Habitat Elements	NPF	Retard	5, 29
River Mill Dam and Powerhouse	FCM: Improve spawning habitat below River Mill dam	UWRC LCC	Spawning	Substrate	NPF	NR	5
River Mill Dam and Powerhouse	Altered flow patterns (peaking/ramping/ timing/ magnitude)	All	All	Altered Flows	NPF	Reduce/Retard	2
River Mill Dam and Powerhouse	Reduced baseflows	All	All	Altered Flows	NPF	Reduce	1
River Mill Dam and Powerhouse	FCM:Ensure adequate minimum flows downstream of River Mill Dam	All	All	Altered Flows	NPF	NR	
River Mill Spillway	Unsafe passage during spill events	UWRC UWRS	Juveniles Kelts	Barrier	NPF	Reduce	

Project Feature	**Effects**	**ESU**	**Life Stage**	**Effect Pathway/ Indicator**	**Baseline Status**	Effect of proposed action	Proposed Studies addressing effect
River Mill Spillway - construction activities	Potential temporary sediment above background levels Potential temporary release of contaminants	All	All	Water Quality		NR	
Off Site Fisheries Conservation Measure	Remediation of stream culverts and road crossings which block fish passage	All	All	Barrier	NPF	NR	
Off Site Fisheries Conservation Measure	Acquire and protect sensitive habitat	All	All	All		NR	

2.1.2.1.3 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. If they are reasonably certain to occur, indirect effects may include other Federal actions that have not undergone Section 7 consultation, but will result from the action under consideration. No indirect effects have been identified from the proposed action during the term of this BO.

2.1.2.2 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

A number of other commercial and private activities, including timber harvest, recreation, urban and rural development, and water supply development, could potentially affect listed species occur in the Clackamas River basin, as discussed below. NOAA Fisheries is not aware of any additional State or private action in the Project area that is reasonably certain to occur or that would affect the listed species or their critical habitat. It is likely that ongoing non-Federal activities that affect listed salmonids and their habitat will continue in the short-term at similar intensities as in recent years.

Non-Federal Timber Harvest
Only 5% of forestland in the watershed is in private ownership. Because the majority of harvestable forestland in the watershed is in Federal ownership, it is unlikely that timber harvest on private lands during the period before the new license is issued will result in detectable impacts to salmonids or salmonid habitat.

Urban and Rural Development
Urban and rural development can contribute to riparian habitat fragmentation, water quality degradation (especially from non-point sources), and other impacts to salmonids and salmonid habitat. Much of the Clackamas River watershed downstream of the Project is used for agriculture. The effects of agricultural and other rural development on salmonids and salmonid habitat in the Clackamas River basin will likely continue at current levels until issuance of the new Project license. It is unlikely that rural development within the Clackamas River basin will threaten the persistence of listed species occurring there.

The town of Estacada is the only urban area in the Project vicinity. Other urban areas in the watershed are the town of Sandy, located near the northern margin of the watershed in the Deep Creek drainage, and the Gladstone/Oregon City area, near the mouth of the Clackamas River. These towns are within 30 miles of Portland and are vulnerable to rapid development as Portland's population increases. It is unlikely that urban development within the watershed over the period until the new Project license is issued will threaten the persistence of listed salmonids.

Water Supply

In October 1996, water providers in the Portland metropolitan region issued the final report of the Regional Water Supply Plan. This plan resulted from a multi-year study to examine strategies and implement actions to meet the water supply needs of the Portland metropolitan area into the year 2050.

The Clackamas River currently provides municipal water to over 200,000 residents in the Portland metropolitan region. Water providers drawing from the Clackamas River, including the City of Lake Oswego, Clackamas River Water, the South Fork Water Board, and the North Clackamas County Commission, have developed intake and treatment capacity for 116 million gallons per day (mgd) on the lower 5 miles of the river. Estacada also has an intake serving about 2,600 residents. The Regional Water Supply Plan for the Portland Metropolitan Area concluded that, "Several new or expanded Clackamas River water supply facilities are already planned for completion within the next 10 years. A total of 22.5 mgd from these projects is included in the baseline capacity assumptions for the regional plan" (Regional Water Suppliers 1996, p. 11). Furthermore, an additional 158.9 mgd of water are proposed for withdraw from municipal water providers in the Clackamas River. These water rights are pending with the Oregon Water Resources Department.

Clackamas River Water and others are evaluating their current capacity to meet the increasing regional needs for high-quality drinking water. Clackamas River Water is working to develop regional partnerships with other water providers in the region to meet these needs. Any additional diversions from the river would further modify hydrologic conditions.

2.1.3 Conclusion

In this BO, NOAA Fisheries must determine whether the action, taken together with cumulative effects, is likely to jeopardize the continued existence of each listed species. As indicated in Section 1, this BO considers the effects of the action on UWR chinook, LCR chinook, and LCR steelhead. The jeopardy analysis involves the following steps: (1) define the biological requirements and current status of the listed species (Section 2.1.1.2), (2) describe the environmental baseline within the action area (Section 2.1.1.4), (3) evaluate the effects of the proposed action on the listed species (Section 2.1.2), and (4) consider the cumulative effects on the listed species (Section 2.1.2.2).

2.1.3.1 Jeopardy Analysis

The final step in NOAA Fisheries' approach to determine jeopardy/adverse modification is to determine whether the proposed action, in light of the above factors, would appreciably reduce the likelihood of species survival. NOAA Fisheries has determined that, when the effects of the proposed action are added to the environmental baseline and cumulative effects occurring in the action area, and given the status of the stocks and condition of important habitat features, the action is not likely to jeopardize the continued existence of each ESU.

As discussed in Section 2.1.1.4, current environmental conditions do not adequately fulfill the biological requirements of UWR chinook, LCR chinook, or LCR steelhead populations. Some of the factors contributing to the status of species under the environmental baseline are a result of historical operations of the Project. The proposed action modifies certain Project operations to improve survival during the interim period and requires completion of studies and plans to correct other adverse Project effects by the end of the interim period. The reasons for concluding that the proposed action will not jeopardize listed species follow:

1. This is an interim BO for a maximum of four years. The current status (abundance, population trends) of the three ESUs in question is such that the ESUs, and their constituent populations affected by the action, have all been identified as threatened as defined by the ESA. A "threatened species" is any species which is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." This indicates that these ESUs have declined from historic levels to the point where their continued viability is in doubt.

   However, it appears likely, assuming no worsening of the environmental baseline, that all three ESUs will survive over the four-year term of this BO. Natural escapement of LCR chinook in the Clackamas River basin is estimated to have averaged about 350 fish in recent years (ODFW 1998b). ODFW considers this population to be depressed, but stable and self-sustaining. Since 1950, hatchery and wild UWR chinook adult returns to the Faraday-North Fork fish ladder (and River Mill dam, prior to 1957) have averaged 1,208 fish, with a high in 1991 of 4,659 fish and a low of 26 fish in 1957. The interim escapement goal for the area above the North Fork Dam is 2,900 fish (ODFW 1998a, as cited in NMFS 2000b). LCR steelhead returns to North Fork Dam between 1963 and 2000 averaged 1,489 fish. A maximum return of 4,353 occurred in 1971, and a low return of 189 fish occurred in 1999. Returns have diminished in this decade and remain far below ODFW's annual escapement goal of 3,000 fish for the habitat above the North Fork Dam. NOAA Fisheries estimated the short-term (i.e., 24 years) extinction risk for Clackamas populations of LCR steelhead to be less than 5% (NMFS 2000b). Thus, it appears that in terms of population size, while still depressed, it is likely that listed populations of Clackamas salmonids will continue to survive during the term of this BO.

   Additional measures protecting wild fish, such as 100% marking of hatchery fish and rules requiring the release of wild fish, increase protection for all three ESUs in the Clackamas. The recent region-wide trend towards increasing returns also increases the likelihood that the three Clackamas salmonid ESUs will remain viable during the four-year term of this BO.

2. During this interim period, adverse effects associated with Project configuration and operation which influenced species status under the environmental baseline will continue. No parts of the proposed action are expected to reduce survival from that which occurred under historical Project operations. Some aspects of the proposed action are likely to result in an unquantifiable increase in survival and productivity of the local populations, compared to that associated with the environmental baseline, specifically:

<u>Passage</u>

- River Mill spillway modification-improvement in downstream migrant survival past River Mill Dam (not in effect until 2004).
- New River Mill fish ladder-improve upstream passage at River Mill Dam (not in effect until 2005).
- Manage spills in the North Fork Project to reduce entrainment in Faraday Powerhouse.

<u>Habitat</u>

- Provide increased operating flows downstream of River Mill Dam.
- Implement a gravel augmentation pilot project downstream of River Mill Dam.

3. In spite of this, continuing adverse Project effects are expected and the ongoing Project effects are unlikely to allow long-term survival and recovery of the ESUs and their constituent populations. Under the proposed action, the Project will continue to appreciably reduce the functioning of already impaired habitat, which will continue to reduce survival and productivity of the local populations, compared to that which would occur if FERC did not license continued operations of the Project. The primary adverse effects are:

<u>Passage</u>

- The Project causes significant barriers to the passage of both upstream migrating adults and downstream migrating juveniles. These barriers impede migration or cause increased mortality in migrating fish.

<u>Water Quality</u>

- From River Mill Dam downstream to the mouth of the Clackamas River, water temperature exceeds 303(d) standards.

<u>Habitat</u>

- Reduced gravel and LWD recruitment degrades habitat in Clackamas River downstream of dams.

<u>Altered Flows</u>

- The Project alters flows from the pre-Project Clackamas hydrological profile both seasonally and at shorter time scales. Specific issues include ramping downstream of hydroelectric projects, reduced flows between Faraday Dam and powerhouse returns, false attraction of upstream migrating salmonids by powerhouse returns, and low flows downstream of River Mill Dam.

4. Reduction of these adverse effects requires additional studies to determine the most effective means of improving Project configuration and operation. Available scientific data is insufficient to determine the most effective means of improving Project configuration and operations to address the remaining adverse effects not addressed in the proposed action. The proposed action requires that solutions for reducing those adverse

effects be developed by 2006. A series of studies, as noted in Table 5, have been planned to address these remaining critical uncertainties in these areas (refer to Table 2):

- Altered Flows: #1-3
- Downstream Passage: #9-23
- Upstream Passage: #30-31
- Habitat Studies: #4-8, 25-29
- Water Quality: #32-35

5. Because the delay associated with these studies will result in continuing adverse Project effects during the interim period, mitigative actions on non-Project lands are also proposed. The proposed action includes a fisheries conservation measure to acquire spawning and rearing habitat for salmon and steelhead in the Clackamas River basin during the interim period. This action should reduce the risks faced by the ESUs, thereby improving survival of local populations of the three listed ESUs.

6. Available information is insufficient for determining if the proposed action will improve the status of the listed ESUs to the point at which biological requirements will be fully met within the action area. However, ongoing NOAA Fisheries Technical Recovery Team efforts and proposed action studies to be completed during the interim period (date of this BO through 2006) are expected to generate much of the needed information.

Although some uncertainties exist, the best available information suggests that the three listed ESUs will continue to survive and retain the potential to recover if the proposed action is implemented during the interim period. Because some of the proposed measures will reduce ongoing adverse effects, as described above, NOAA Fisheries concludes that these improvements will be sufficient to reduce the likelihood of extinction while studies are completed. Therefore, NOAA Fisheries concludes that the proposed action, together with the effects of the environmental baseline and cumulative effects, is consistent with the biological requirements and not likely to jeopardize the continued existence of UWR chinook, LCR chinook, and LCR steelhead in the time period from the date of this BO through August 2006.

2.1.4 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NOAA Fisheries has no conservation recommendations to make at this time.

2.1.5 Reinitiation of Consultation

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this BO, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat no considered in this BO, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation, unless such action is not expected to constitute an irreversible or irretrievable commitment of resources that has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures that would not violate 16 USC §1536(a)(2).

FERC has provided NOAA Fisheries with a BA describing a proposed action to occur during the interim period addressed by this BO. FERC's BA contemplates incorporation of this proposed action into amended license articles for the Project. In the event that the amended license fails to incorporate the proposed action as analyzed in this BO, then the conclusions of this BO and the protection afforded by the Incidental Take Statement do not apply and FERC should reinitiate consultation under Section 7 of the ESA to seek NOAA Fisheries' opinion on the alternative action.

This BO analyzes actions to be implemented through the expiration of the current license on August 31, 2006. At that time, NOAA Fisheries expects that another BO developed pursuant to a consultation with FERC relating to the relicensing of the entire Project will supercede this BO. An extension of the proposed action beyond August 31, 2006, through annual licenses has not been addressed in this BO and would require reinitiation of consultation. Depending upon the circumstances resulting in the delay, NOAA Fisheries may elect to extend the effective date of this BO.

2.2 Incidental Take Statement

Sections 4(d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined in 50 CFR §222.102 as "an act that may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering." Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed species that results from, but is not the purpose of, the Federal agency or the Applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides RPMs that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the RPMs.

2.2.1 Amount and Extent of Anticipated Take

NOAA Fisheries anticipates that the proposed action will cause more than a negligible amount of incidental take of UWR chinook, LCR chinook, and LCR steelhead for the reasons presented in this BO. Take examples may include juvenile harm or mortality caused by stranding in some Project reaches, and delay or injury during adult and juvenile passage at Project dams. Despite the use of the best scientific and commercial data available, NOAA Fisheries cannot quantify a specific amount of incidental take or individual fish or incubating eggs for this action. Instead, the extent of take is anticipated to be that associated with the operation of the Project in accordance with the measures of the preferred alternative in the license amendment issued by FERC.

2.2.2 Effect of Anticipated Take

As analyzed in this BO, NOAA Fisheries has determined that this extent of anticipated take is not likely to jeopardize the continued existence of UWR chinook, LCR chinook, and LCR steelhead.

2.2.3 Reasonable and Prudent Measures

Reasonable and prudent measures (RPM) are non-discretionary measures to minimize take that are not already part of the description of the proposed action. They must be implemented as binding conditions for the exemption in Section 7(a)(2) to apply. FERC has the continuing duty to regulate the activities covered in this incidental take statement. If FERC fails to require the Applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. NOAA Fisheries believes that activities carried out in a manner consistent with these RPMs, except those otherwise identified, will not necessitate further site-specific consultation. Activities which do not comply with all relevant RPMs will require further consultation.

NOAA Fisheries believes that the following RPMs are necessary and appropriate to minimize the effect of anticipated incidental take of UWR chinook, LCR chinook, and LCR steelhead. FERC must require PGE to:

1. Minimize the likelihood of incidental take associated with Project operations by providing adequate instream flows, minimizing flow fluctuations, managing riparian vegetation, and controlling erosion and sediment.

2. Minimize the likelihood of incidental take from construction activities in or near watercourses by restricting instream work to recommended time periods, implementing pollution and erosion control measures, and avoiding or replacing lost riparian and instream functions.

3. Mitigate the effect of incidental take by providing fish passage to upstream habitat.

4. Mitigate the effect of incidental take by restoring fluvial geomorphic processes, enhancing spawning habitat, providing additional aquatic connectivity, providing access to upstream habitat, and funding tributary enhancement and other mitigation measures.

5. Monitor the effectiveness of the proposed protection, minimization and enhancement measures in minimizing the effect of incidental take and report monitoring results to NOAA Fisheries.

2.2.4 Terms and Conditions

In order to be exempt from the take prohibitions of Section 9 of the ESA and regulations issued pursuant to Section 4(d) of the ESA, FERC must include in the license amendment and PGE must implement the following terms and conditions, which implement the RPMs listed above. These terms and conditions are non-discretionary.

1. Implement the fisheries conservation measures described in Section1.2.3.3:

a. Implement a gravel augmentation pilot project downstream of River Mill Dam as noted in the BE, Section 9.1.3, page 86.

b. Measure 4 - manage spills in the North Fork Project to reduce entrainment in Faraday Powerhouse as noted in the BE, Section 9.2.4, page 92.

c. Provide increased operating flows downstream of River Mill Dam as described in the BE, Table 9.1, page 88, and Section 9.1.4, page 86.

d. Acquire critical spawning and rearing habitat for salmon and steelhead in the Clackamas River basin as described in the BE, Section 9.2.7, page 93.

e. Remediate culverts and road crossings as described in the BE, Section 9.1.8, page 89.

2. Execute the River Mill Dam spillway, ladder, and bypass exit pipe modifications noted in Sections 1.2.3.1.2 and 1.2.3.3 and described in the BA and BE, Sections 3.1.3 and 3.1.4, and Appendix B of the BE, within the time frame of 2003-2005.

3. Follow the construction practices described in Section 1.2.3.1.3 and in Appendix B of the BE and in number 6 below to control sediment, disturbance, and other potential detrimental effects to listed Clackamas salmonids during construction and the following conditions for construction activities in or near water courses.

4. Obtain NOAA Fisheries' written approval on final design, construction practices, and schedule before beginning construction of River Mill Dam spillway modification, bypass outfall and fish ladder, and Faraday-Northfork trap reconstruction.

5. Complete studies described in Section 1.2.4 and Appendix A of the BE and apply findings to address critical uncertainties and remaining negative Project effects at relicensing.

6. In all proposed actions involving construction near water courses FERC shall require PGE to:

a. All in-water work occurring on the downstream side of River Mill Dam shall be completed within the work period of July 15 to August 31 (ODFW 2000).

b. No in-water work shall take place outside this work period without prior written authorization from NOAA Fisheries, in consultation with ODFW.

c. Construction activities associated with habitat enhancement and erosion control measures shall meet or exceed best management practices and other performance standards contained in the ODEQ for the National Pollutant Discharge Elimination System 1200-CA permit (General NPDES Stormwater Discharge Permit).

d. All erosion control devices shall be inspected weekly, at a minimum, during construction to ensure that they are working adequately.

e. Erosion control materials (e.g., silt fence, straw bales, aggregate) in excess of those installed shall be available on-site for immediate use during emergency erosion control needs.

f. Vehicles operated within 150 ft of the waterway are free of fluid leaks. Daily examination of vehicles for fluid leaks is required during periods operated within or above the waterway.

g. During completion of habitat enhancement activities, no pollutants of any kind (sewage, waste spoils, petroleum products, etc.) shall come in contact with the water body or wetlands nor their substrate below the mean high-high water elevation or 10-year flood elevation, whichever is greater.

h. Any areas used for staging, access roads, or storage are to be evacuated and all materials, equipment, and fuel shall be removed if flooding of the area is expected to occur within 24 hours.

i. Vehicle maintenance, refueling of vehicles, and storage of fuel shall be done at least 150 ft from the waterway.

j. At the end of each work shift, vehicles shall not be stored within or over the waterway.

k. Prior to operating within the waterway, all equipment shall be cleaned of external oil, grease, dirt, or caked mud. Any washing of equipment shall be conducted in a location that shall not contribute untreated wastewater to any flowing stream or drainage area.

l. Temporary erosion and sediment controls will be used on all exposed slopes during any hiatus in work exceeding 7 days.

m. Material removed during excavation will only be placed in locations where it cannot enter sensitive aquatic resources. Whenever topsoil is removed, it shall be stored and reused on-site to the greatest extent possible.

n. Alteration or disturbance of the stream banks and existing riparian vegetation will be minimized to the greatest extent possible.

o. No herbicide application shall occur as part of this action. Mechanical removal of undesired vegetation and root nodes is permitted.

p. Clearing limits shall be identified and marked. Construction activity or movement of equipment into existing vegetated areas shall not begin until clearing limits are marked.

q. All existing vegetation within 150 ft of the edge of bank should be retained to the greatest extent possible.

NOAA Fisheries will be reviewing the detailed construction plans submitted per Section 1.2.3.1.3 to advise FERC regarding whether or not those plans are likely to meet the "best management practices" anticipated in the BE, as articulated in the Incidental Take Statement Terms and Conditions (Section 2.2.4, 6 a-q).

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

3.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).
- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)).
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH, waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR §600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR §600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

3.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

3.3 Proposed Action

The proposed action and action area are detailed above in Section 1.2 of this BO. The action area includes habitats that have been designated as EFH for various life-history stages of chinook and coho salmon.

3.4 Effects of Proposed Action

As described in detail in Section 2.1.2 of this BO, the proposed action may result in short- and long-term adverse effects to a variety of habitat parameters. These adverse effects are:

1. Upstream migration barriers, inadequate upstream passage at three lower Project dams.
2. Downstream migration barriers, inadequate downstream passage facilities at three lower Project dams.
3. Elevated water temperatures associated with three lower Project dams.
4. Inadequate spawning gravel downstream of River Mill Dam, three lower Project block substrate/gravel recruitment.
5. Reduced flows and ramping associated with operations of Oak Grove and Faraday powerhouses degrades habitat.

3.5 Conclusion

NOAA Fisheries concludes that the proposed action would adversely affect designated EFH for chinook and coho salmon.

3.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. While NOAA Fisheries understands that the conservation measures described in the BE and BA will be implemented by the FERC, it does not believe that these measures are sufficient to address the adverse impacts to EFH described above. However, the Terms and Conditions outlined in Section 2.2.4 are generally applicable to designated EFH for chinook and coho salmon and address these adverse effects. Consequently, NOAA Fisheries recommends that they be adopted as EFH conservation measures.

3.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR §600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

3.8 Supplemental Consultation

The FERC must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR §600.920(k)).

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APPENDIX A - LISTED SALMONID LIFE HISTORY PARAMETERS AND POPULATION DYNAMICS IN THE ACTION AREA

UPPER WILLAMETTE RIVER CHINOOK

Life History

Life history type

Spring (or "stream-type") chinook salmon typically spend up to one year rearing in fresh water (although some may migrate as subyearlings) before migrating to sea, perform extensive offshore movements, and return to their natal river in the spring or summer, several months prior to spawning (Moyle et al. 1989; Healey 1991).

Adult returns

The age composition of returning Clackamas spring chinook spawners during 1979-1987 was, in order of prevalence, 4- (67.2%), 5- (28.1%), 3- (4.2%), and 6- (0.4%) year-old fish. Most naturally produced spring chinook adults enter the LCR from mid-March through late April, although some spring chinook may be caught in Clackamas River basin as early as January. The majority of upstream migrants pass North Fork Dam in June through October, with migration peaks in July and September.

Since they enter the Clackamas River up to four months before spawning, spring chinook require holding habitat where they will remain until spawning in September and October. Adult spring chinook require large, deep pools with moderate flows for summer holding during their upstream migration. Chinook adults usually hold in pools deeper than 4.9 ft (1.5 m) that contain cover from undercut banks, overhanging vegetation, boulders, or LWD (Lindsay et al. 1986).

Spawning

Spawning begins in August and peaks in late September. Spring chinook salmon spawn primarily in the mainstem Clackamas River and larger tributaries. In the lower basin, spawning occurs downstream of the Project in Eagle Creek, and within the Project between River Mill and Faraday dams. Upstream of the Project, spawning occurs in the mainstem Clackamas River from the head of North Fork Reservoir upstream to Big Bottom, and in tributaries including lower Fish Creek, Roaring River, Collawash River, and the Hot Springs Fork of Collawash River (ODFW 1992). The highest spawning densities are found from the head of North Fork Reservoir upstream to Sisi Creek (RM 33 to RM 74) (Schroeder et al. 1997, as cited in Romey and Cramer 1999). On the Oak Grove Fork, a 20-ft (6.1-m) waterfall one mile downstream of Lake Harriet Diversion Dam limits spring chinook distribution. Areas of high quality spawning habitat in the upper basin, such as Big Bottom (RM 64-68) and the Hot Springs Fork, appear to be underutilized, with adults tending to concentrate below River Mill and Faraday dams.

Chinook eggs in the Clackamas River hatch after a four- to six-month incubation period, the length of which depends on water temperature. The alevins remain in the gravel for two to three weeks after hatching and absorb most of their yolk sac before emergence from the gravels into the water column. Emergence probably occurs in January and February.

Length of freshwater residence

Spring chinook freshwater residency is highly variable. Spring chinook in the Clackamas River basin may disperse downstream as fry soon after emergence, early in their first summer as fingerlings, in the fall as flows increase, or after overwintering in freshwater as yearlings (Healey 1991).

Juvenile spring chinook salmon do not appear to rear in the tributaries, but rather appear to emigrate to the mainstem soon after emergence (ODFW 1992). Some juvenile spring chinook salmon may rear in the reservoirs within the North Fork Project (ODFW 1992). The Oregon Fish Commission (1964) determined that conditions in North Fork Reservoir are suitable for spring chinook salmon rearing. Smolt production is far below estimates of potential smolt production for the upper basin. The 1986-1991 average annual North Fork Dam count of 19,613, compared to an estimated potential smolt production range of 190,880 to 1,365,028, suggests that densities of juveniles in rearing habitats is probably low (ODFW 1992).

Downstream migration

Downstream migrating juveniles have been detected at North Fork Dam in all months of the year. There are two peak migration periods: April-May (the largest single month count) and October-November (the second largest single month count).

Estuary rearing

Estuary rearing periods for yearling smolts is relatively short, just a few days. Subyearling smolts may behave similarly to fall chinook, spending one to two months feeding and growing in the estuary before entering the ocean. Clackamas River spring chinook use the Columbia River estuary near Astoria, Oregon.

Population Dynamics

Hatchery influence in the action area

Numerous hatcheries in the Clackamas River basin historically produced spring chinook salmon. As was common practice at the time, these hatcheries blocked the river with racks to collect as many returning adults as possible. The fishways at River Mill and Cazadero (now Faraday Diversion) dams were initially used to capture fish for broodstock rather than to pass fish upstream. For several years beginning in 1911, all spring chinook salmon migrating up the Clackamas River were trapped at River Mill Dam and used for hatchery brood stock. The last remnants of the native spring chinook salmon run apparently were transplanted to Delph Creek (a tributary to Eagle Creek) for use in fish culture operations, beginning in 1937 (Gunsolus and Eicher 1970).

Several out-of-basin hatchery stocks have been used to supplement the Clackamas River spring chinook salmon population (ODFW 1992). Stocks from the Sandy River were released in 1892–1999, and stocks from California were released in 1895. Other Willamette River basin hatchery stocks, including Marion Forks, Oakridge/Dexter, and South Santiam, have provided most of the broodstock used in recent years (ODFW 1992). Recent hatchery production has occurred at the Eagle Creek NFH and the Clackamas Hatchery. From 1957 to 1987, spring chinook salmon were produced at the Eagle Creek NFH using primarily Willamette River basin stocks. Cold water temperatures, however, impaired rearing, and spring chinook salmon production was transferred to the Clackamas Hatchery. Since 1986, the Clackamas Hatchery has been the only hatchery in the basin to produce spring chinook salmon (ODFW 1992). The current production target is 188,889 pounds (85,680 kg) of smolts, of which 116,667 pounds (52,920 kg) (1.05 million smolts) are released into the Clackamas River basin. From 1980 to 1986, the Clackamas Hatchery released an average of 820,000 spring chinook salmon smolts each year into the Clackamas River basin. Releases during 1986–1990 ranged from 623,340 to 1,415,090 smolts annually. Except in 1982 and 1983, all smolts were released directly from the Clackamas and Eagle Creek hatcheries. In 1982 and 1983, smolts from the Clackamas Hatchery were released upstream of River Mill Dam. Fry and pre-smolts have been released at various locations throughout the basin (ODFW 1992).

The current ratio of hatchery to wild fish in the escapement is unknown, but the proportion of hatchery fish is believed to have increased in recent years as a result of an increase in the number of hatchery smolts released into the basin. Analysis of the component of the adult salmon run returning in 1972 that had been marked with oxytetracycline (OTC) indicated that adults from the UWR hatcheries comprised at least 47% of the Clackamas River spring chinook salmon population for that year (Willis et al. 1995). Because not all UWR hatcheries marked released smolts with OTC during the 1967 or 1968 brood years, the actual hatchery component may have been higher as a result of straying. Since 1998, all hatchery spring chinook salmon have been marked. In winter 2000, the ratio of marked to unmarked spring chinook that returned to the hatchery (all of which are assumed to be of hatchery origin) was equal to the marked/unmarked fish ratio for the spring chinook returns to the North Fork trap, suggesting that, at this time, nearly all spring chinook returns are of hatchery origin.

In 1982, 1983, and 1984, PGE trucked adult spring chinook salmon (including naturally produced and possibly hatchery fish) to the upper Clackamas River to seed spawning areas in an attempt to return production in the upper watershed to turn-of-the-century levels (PGE 1997). This practice was discontinued, however, and fish are no longer trucked any further upstream than North Fork Reservoir to minimize the occurrence of hatchery fish in upstream areas.

PGE currently operates a trap and sorting facility at the Faraday-North Fork fish ladder. In 1999, the trap at the dam was rebuilt to sort all upstream migrating adult salmon. Since that time, all unmarked spring chinook salmon have been allowed to pass upstream or have been trucked upstream, while marked fish have been returned to the lower river. In 2000, this facility was remodeled again to further improve sorting abilities. Until 2003, not all hatchery fish returning to the Clackamas River basin were marked.

Action area population trends

In March 1999, NOAA Fisheries determined that the UWR chinook ESU warranted listing as a threatened species under the ESA (NMFS 1999). Evidence indicates that runs in the Clackamas River have been reduced compared to historical levels. Native cultures have been harvesting salmon from the Clackamas for 4,000 to 6,000 years, and a thriving commercial fishery for chinook in the Clackamas River existed prior to the turn of the century (U.S. Commission of Fish and Fisheries 1895, as cited in Romey et al. 2001). Spring chinook likely spawned in the middle and upper Clackamas River basin, where temperatures would have been favorable (Romey et al. 2001). By the late nineteenth century, reports identified impacts of overharvesting, and calls were made for reductions in harvest (U.S. Fish Commission 1877, as cited in Romey et al. 2001).

In 1877, the first hatchery to be built in the Columbia River basin was constructed on the Clackamas River to help spring chinook recovery. In 1893, an estimated 8,000 spring chinook were harvested from the lower Clackamas River, and in 1894 an estimated 12,000 fish were taken for hatchery purposes (ODFW 1992, as cited in Filbert 2001). By 1904, anglers were already noticing the decline or extinction of several unique populations in the Clackamas River (Romey et al. 2001). Since 1950, hatchery and wild adult returns to the Faraday-North Fork fish ladder (and River Mill Dam prior to 1957) have averaged 1,208 fish, with a high in 1991 of 4,659 fish and a low of 26 fish in 1957. The interim escapement goal for the area above the North Fork Dam is 2,900 fish (ODFW 1998a, as cited in NMFS 2000b). Currently, the abundance of spring chinook in the Clackamas River is strongly influenced by hatchery releases. Hatchery and natural production of spring chinook in the Clackamas River currently accounts for about 20% of the production potential in the Willamette River basin (NMFS 2000b). NOAA Fisheries considers the naturally spawning population a potentially important genetic resource for recovery (NMFS 2000b).

LOWER COLUMBIA RIVER CHINOOK

Life History

Life history type

Fall or ocean type chinook salmon migrate downstream shortly after emergence. The smolts spend one to three months rearing in the estuary before entering the ocean. During their ocean residence, fall chinook typically remain in coastal waters. Upon maturation, they enter their natal river in the fall (thus the name "fall chinook") and spend a relatively short time there before spawning.

Although the Clackamas River is believed to have historically supported a large run of fall chinook, little is known about them. The spring chinook run has received much more attention because of its greater importance to angling and commercial harvest. Additionally, Clackamas River fall chinook do not pass through any ladders or other fish counting facilities, making data collection difficult.

Adult returns

Populations in this ESU spend most of their ocean life in coastal waters, mature at ages 3 and 4, and return to their natal river in the fall, a few days or weeks before spawning (Moyle et al. 1989; Healey 1991). Fall chinook adults enter the Clackamas River basin between July and October, with migration peaks in September.

Spawning

Fall chinook salmon tend to be larger than spring chinook salmon and display slightly different spawning habitat preferences. Like spring chinook, fall chinook tend to spawn in the mainstem and lower reaches of major tributaries, although often in deeper water, and in larger substrates than spring chinook (Burner 1951; Healy 1991). Currently, fall chinook in the Clackamas River only spawn below River Mill Dam in the mainstem Clackamas River and in lower Clear Creek , although historical accounts document spawning upstream of the present North Fork Project (ODFW 1992). Spawning typically occurs in September and October.

Incubation/rearing

Fall chinook juveniles move downstream either immediately following emergence in January or February, or as two- to four-month-old smolts (Lister and Genoe 1970). Juvenile fall chinook occupy backwater and stream margin habitat where there is slow, shallow water and refuge from high flows. They have often been observed to school in groups of 20 to 40 individuals. Young fry have also been observed to use pool margins and pool tails associated with bedrock obstructions, rootwads, and overhanging banks. Juvenile chinook appear to prefer deep, downstream portions of pool heads where velocity is lowest (Reedy 1995). Overwintering habitat typically is not used by fall chinook because they emigrate to the ocean in the spring or summer following emergence.

Downstream migration

Since fall chinook spawn downstream of River Mill Dam, there are no traps or other facilities which allow detection of downstream migrating fish.

Estuary rearing

Fall chinook begin their downstream migration soon after emergence and are relatively small upon their arrival at the estuary. Typically, fall chinook smolts will spend one to two months feeding and growing in the estuary before entering the ocean in late summer to early fall. The time spent in the estuary allows smolts to enter the ocean at relatively large sizes (10–16 cm) and may increase ocean survival (Nicholas and Hankin 1989). Clackamas River fall chinook rear in the Columbia River estuary.

Ocean

Coded wire tag recoveries for LCR ESU populations indicate a northerly migration route, but with little contribution to the Alaskan fishery.

Population Dynamics

Hatchery influence in the action area

A variety of fall chinook salmon stocks were released in the Clackamas River basin from early hatcheries, the majority being of LCR origin (Howell et al. 1985). Most fall chinook salmon hatchery releases into the Clackamas River were pre-smolts and occurred between 1951 and 1971. A maximum release of 5,685,000 occurred in 1958 (ODFW 1992, as cited in Filbert 2001). No hatchery-produced fall chinook salmon have been released into the Clackamas River basin since 1981.

Population trends in the action area

The Clackamas River is believed to have historically supported a large run of fall chinook salmon (Fulton 1968, as cited in ODFW 1992). Fall chinook salmon are known to have spawned in the mainstem of the Clackamas River above the site of North Fork Dam prior to the construction of the dam (Fulton 1968, as cited in ODFW 1992). Potential factors that may have led to the end of fall chinook salmon spawning upstream of the North Fork Project include: (1) blocking of upstream passage during the State's periodic egg-taking operations at the River Mill fish ladder after it was constructed in 1912; (2) lack of upstream passage from 1917–1939 after high flows washed out the original fish ladder at Faraday Diversion Dam (Taylor 1999); and (3) serious water quality problems by the late 1940s in the Willamette River downstream of Willamette Falls during the late summer and early fall low flow periods, when fall chinook salmon migrated upstream (Dimick and Merryfield 1945, as cited in Kostow 1995).

In March 1999, NOAA Fisheries determined that the LCR chinook ESU warranted listing as a threatened species under the ESA (NMFS 1999). Little information exists on fall chinook in the Clackamas River basin because: (1) they do not pass a counting station prior to entering the Clackamas River, (2) they do not migrate upstream past River Mill Dam, and (3) spring chinook salmon runs are 3 to 10 times larger than the fall run and have overwhelmed the fall run in terms of management importance (ODFW 1992). Also, historical records of hatchery operations on the Clackamas River do not distinguish between fall and spring chinook salmon (ODFW 1992). Fall chinook salmon that currently are sustained by natural production in the Clackamas River are believed to have largely originated from hatchery tule stocks that were extensively released into the Clackamas River beginning in 1952, but may also include fall chinook salmon that have strayed from other Willamette tributaries (ODFW 1992; Olsen et al. 1992; Kostow 1995). Natural escapement of fall chinook salmon in the Clackamas River basin is estimated to have averaged about 350 fish in recent years (ODFW 1998b). ODFW considers this population to be depressed, but stable and self-sustaining.

UPPER WILLAMETTE RIVER STEELHEAD

Life History

Life history type

Steelhead is the term used to distinguish anadromous populations of rainbow trout from resident populations. Wild Clackamas River basin steelhead are classified as winter steelhead, entering the basin between January and April. They share the basin with two non-indigenous hatchery stocks of winter steelhead and what is probably a non-indigenous stock of summer steelhead.

Adult returns

Steelhead return to spawn in their natal stream, usually in their fourth or fifth year of life, with males typically returning to freshwater earlier than females (Shapovalov and Taft 1954; Behnke 1992). A small percentage of steelhead may stray into streams other than those in which they were born. Although the majority of steelhead populations are either primarily winter-run or summer-run, adults may enter spawning streams in almost any month of the year, and spawning may occur at any time from January to June (Behnke 1992; NMFS 1996). In the Clackamas River basin, winter-run steelhead enter the system between January and April.

Spawning

Clackamas River steelhead typically begin spawning in April and May. Winter steelhead spawn throughout most of the Clackamas River basin. Downstream of the Project, winter steelhead spawn in the lower mainstem Clackamas River and in major tributaries, including Clear, Deep, Eagle, and Fish creeks. Upstream of the North Fork Project dams, winter steelhead spawn in the upper mainstem Clackamas River; the North and Oak Grove forks of the Clackamas River; and Roaring River and Collawash River, including the Hot Springs Fork (ODFW 1992). The contribution to juvenile production resulting from spawning in the upper watershed relative to downstream of the dam has not been determined. Radio-tracking surveys conducted by PGE suggest that wild winter steelhead may spawn in the mainstem river downstream of the Project (Turner 1998a). Radio-tracking of adult steelhead in 1999 and 2000 indicated at least occasional use of the upper mainstem Clackamas River, Fish Creek, Collawash River, and North Fork Reservoir (Shibahara 2000a; Cramer 2000).

Unlike salmon, steelhead may survive spawning and return to the ocean, then return to spawn in later years. Steelhead which have recently spawned are known as “kelts.” Kelts have been observed at the North Fork Dam before June, suggesting that spawning is probably complete at this time (ODFW 1992).

Incubation/rearing

Juveniles emerge in June and July. After emergence from spawning gravels in spring or early summer, steelhead fry move to shallow-water, low-velocity habitats such as stream margins and low-gradient riffles and may forage in open areas lacking instream cover (Hartman 1965; Everest et al. 1986; Fontaine 1988). As fry increase in size in late summer and fall, they increasingly use areas with cover and show a preference for higher-velocity, deeper mid-channel waters near the thalweg (Hartman 1965; Everest and Chapman 1972; Fontaine 1988). In general, age 0+ steelhead occur in a wide range of hydraulic conditions (Bisson et al. 1988), appearing to prefer water less than 50 cm (19.5 inches) deep with velocities below 0.3 m/s (1.0 ft/s) (Everest and Chapman 1972). Age 0+ steelhead have been found to be relatively abundant in backwater pools and often use the downstream ends of pools in late summer (Bisson et al. 1988; Fontaine 1988).

Older age classes of juvenile steelhead (age 1+ and older) occupy a wide range of hydraulic conditions. They prefer deeper water during the summer and have been observed to use deep pools near the thalweg with ample cover, as well as higher-velocity rapid and cascade habitats (Bisson et al. 1982; Bisson et al. 1988). Age 1+ fish typically feed in pools, especially scour and plunge pools, resting and finding escape cover in the interstices of boulders and boulder-log clusters (Fontaine 1988; Bisson et al. 1988). Age 1+ steelhead appear to avoid secondary channel and dammed pools, glides, and low-gradient riffles with mean depths less than 20 cm (7.80 inches) (Fontaine 1988; Bisson et al. 1988; Dambacher 1991).

Preferred rearing temperatures range from 7.2º to 14.4ºC (45.0º to 57.9ºF), with optimum temperature for juveniles occurring from 10º to 12.8ºC (50.0 to 55.0ºF) and lethal temperatures occurring at 23.8ºC (74.84ºF) (Bell 1991). Preferred emigration temperatures are <13ºC (57ºF). In winter, steelhead occur in pools, especially low-velocity deep pools with large rocky substrate or LWD for cover, including backwater and dammed pools (Hartman 1965; Raleigh et al. 1984; Swales et al. 1986; Fontaine 1988). Age 1+ steelhead prefer water deeper than 45 cm (17.5 inches), while age 0+ steelhead often occupy water less than 15 cm (5.9 inches) deep and are rarely found at depths over about 60 cm (23.4 inches). Below 7ºC (44.6ºF), juvenile steelhead prefer water velocities <15 cm/s (0.5 ft/s) (Bustard and Narver 1975). Juveniles often use the interstices between substrate particles as overwintering cover. Bustard and Narver (1975) typically found age 0+ steelhead using 10-25 cm (3.90-9.75 inch) diameter cobble substrates in shallow, low-velocity areas near the stream margin. Everest et al. (1986) observed age 1+ steelhead using logs, rootwads, and interstices between assemblages of large boulders (>100 cm [39 inches] diameter) surrounded by small boulder- to cobble-size (50-100 cm [19.7–39 inches] diameter) materials as winter cover. Age 1+ fish typically stay within the area of the streambed that remains inundated at summer low flows, while age 0+ fish frequently overwinter beyond the summer low flow perimeter along the stream margins (Everest et al. 1986).

North Fork Dam counts of downstream migrating juvenile steelhead in 1978-1986 averaged 44,067, far below the estimated production capacity range of 129,557 to 201,500, suggesting that juvenile densities in rearing habitat are probably low (ODFW 1992).

<u>Downstream migration</u>
Downstream migrating smolts have been captured at North Fork Dam in every month of the year. However, the majority of the downstream migration occurs in April-June, peaking in May. There appears to have been a shift in migration timing between 1963 and 1991, with increasing numbers of fish migrating in March and April.

Estuary rearing

Juveniles from the Clackamas River basin use the Columbia River Estuary during their estuary rearing period.

Ocean

Little is known about steelhead use of ocean habitat, although changes in ocean conditions are important for explaining trends among Oregon coastal steelhead populations (Kostow 1995). Ward and Slaney (1988) suggested that increased ocean temperatures associated with El Niño events may increase ocean survival. The magnitude of upwelling, which determines the amount of nutrients brought to the ocean surface and which is related to wind patterns, influences ocean productivity with significant effects on steelhead growth and survival (Barnhart 1991). Steelhead appear to prefer ocean temperatures of 9ºC–11.5ºC (48.2ºF–52.7ºF) and typically swim in the upper 9–12 m (29.5–39.4 ft) of the ocean's surface (Barnhart 1991).

Population Dynamics

Hatchery influence in the action area.

Three stocks of winter steelhead occur in the Clackamas River basin: (1) a native late-spawning wild stock, (2) Eagle Creek stock (also referred to as Clackamas River ODFW stock #19 [NMFS 1998]), and (3) Big Creek Hatchery stock (ODFW 1992). Hatchery stocks of winter steelhead in the Clackamas River basin belong to the ESU, but are not considered essential for recovery and are not listed as threatened. All naturally spawning winter steelhead, however, are included in the listing, including the progeny of hatchery fish that spawn naturally in the river.

Eagle Creek NFH began releasing winter steelhead smolts into tributaries of the Clackamas River (primarily Eagle Creek) in 1958. This hatchery also provides fry for rearing at the Clackamas Hatchery. The Eagle Creek stock is a mixed broodstock that includes winter steelhead of Big Creek, Clackamas River, Donaldson rainbow, and perhaps Alsea River origins (Kostow 1995). Hatchery winter steelhead are released only downstream of River Mill Dam. The annual production goals for the Eagle Creek NFH change frequently but were reported as 150,000 smolts by ODFW (1992) and as 70,000 fry for transfer to the Clackamas Hatchery and 200,000 smolts for on-station releases (Montgomery Watson 1997). The annual production goal for winter steelhead smolts at the Clackamas Hatchery (produced from Eagle Creek NFH fry) is 30,000 fish. This goal has been exceeded in most years (ODFW 1992). Since 1986, about 44,000 winter steelhead smolts have been released annually from the Clackamas Hatchery (ODFW 1992).

From 1979 to 1988, average annual release of winter steelhead from the Eagle Creek Hatchery was 143,000. Most winter steelhead are released in April and May as yearling smolts at a size of 13–22 fish/kg (ODFW 1992), but some are released as fingerlings and fry at 22–4,400 fish/kg (Howell et al. 1985, as cited in ODFW 1992). From 1976 to 1991, average winter steelhead return to the Eagle Creek NFH was 686 fish (range 271–1,431 fish), with most adults returning from January through April (ODFW 1992). Eagle Creek steelhead return primarily as three-year-olds at an average weight of seven pounds (ODFW 1992). NMFS (1998) did not consider the

Eagle Creek NFH stock and the Clackamas River ODFW stock #20 to be part of the ESU based on the substantial inclusion of original broodstock from outside of the ESU and on significant deviation from current run-timing from the native winter-run steelhead population.

Big Creek stock was first released into the basin in 1964 (ODFW 1992). This stock was released extensively in the Clackamas River until 1999, when releases of this stock in the basin were halted (Cramer et al. 1997). This stock originated from a Southwest Washington ESU stock (Cramer et al. 1997; NMFS 1998). This stock returns to the river earlier than the native stock and was developed to improve angler harvest in January and December. Most of the adult Big Creek hatchery steelhead pass over the North Fork Dam prior to March 1 (Olsen et al. 1992, as cited in Willis and Cramer 1997). Adult steelhead passing over the dam after March 1 tend to be predominantly native Clackamas stock (Willis and Cramer 1997). Chilcote (1998) used March 31 as a cutoff criterion for obtaining an index of wild fish in the basin. Based on recent genetic analysis, few of the juvenile steelhead produced upstream of the dam belong to Big Creek stock (Cierebiej et al. 1996, as cited in Willis and Cramer 1997). Releases of this stock below North Fork Dam in 1979–1988 averaged 132,400 at 5 fish per pound and ranged from 20,070 to 178,875 fish (ODFW 1992).

In addition to these hatchery programs, PGE, ODFW, and the Oregon Wildlife Heritage Foundation began a native broodstock program on the Clackamas River in 1991. For this program, adult winter steelhead are collected at the Faraday-North Fork ladder. These fish are spawned and the eggs are incubated and hatched at the Clackamas Hatchery. Fry are transferred to the Oak Springs Hatchery on the Deschutes River for rearing. This program is intended to contribute to the recreational fishery and reduce angling pressure on depressed wild stocks. Between 1991 and 1999, the release target for this broodstock was 40,000 smolts annually. With the termination of releases of Big Creek stock into the basin in 1999, the native broodstock release target was increased to 120,000 smolts annually. This stock (referred to by NMFS 1998 as Clackamas River ODFW stock #122) was included in the LCR ESU because of its origin from a local wild population, but was not included as being essential for recovery and, therefore, is not listed as threatened at this time (NMFS 1998).

From 1961 to 1996, 16% of the winter steelhead passing over North Fork Dam were of hatchery origin. Since 1995, PGE has worked jointly with ODFW to trap and sort all winter steelhead passing upstream at the Faraday-North Fork fish trap. Hatchery steelhead caught in the trap are hauled back downstream and released downstream of River Mill Dam. Beginning in 2000, hatchery fish from native broodstock have also been separated and released downstream. Currently, only wild winter steelhead are allowed to pass upstream above the North Fork Dam (Willis and Cramer 1997).

The widespread occurrence of hatchery fish in naturally spawning steelhead populations throughout the LCR ESU is a major concern (NMFS 1998). Competition, genetic introgression, and disease transmission resulting from hatchery introductions may reduce the production and survival of native, naturally reproducing steelhead (NMFS 1998). Hatchery summer steelhead are also released into the Clackamas River basin. Some natural production of this summer hatchery stock is assumed to occur, and competition with non-native summer steelhead is considered to be a major factor affecting the native winter steelhead population. Chilcote (1998) concluded that the introduction of non-native summer steelhead to the Clackamas River basin likely reduced winter steelhead productive capacity and resulted in a 27% decrease in the population's resiliency. Exclusion of summer steelhead from passage above the North Fork Dam has occurred since 1999. Recently implemented changes in hatchery release practices by ODFW are generally believed by NOAA Fisheries to be positive, but NOAA Fisheries believes that the influence of these changes will be relatively minor compared with widespread artificial propagation and the history of stock transfers within the ESU (NMFS 1998).

Population trends in the action area

Historical records, although incomplete, indicate that steelhead runs in the Clackamas River were much larger than under current conditions. Steelhead historically occupied more of the Clackamas River basin than either chinook or coho salmon, because of their tolerance of higher gradient habitat (Romey et al. 2001). By 1890, commercial harvest in the LCR focused on steelhead, many of which were thought to have originated in the Clackamas River basin (Lichatowich and Mobrand 1995, as cited in Romey et al. 2001). Records show that in 1895, nearly half of all commercial fish caught in the lower Clackamas River were winter steelhead (U.S. Commission of Fish and Fisheries 1895, as cited in Romey et al. 2001). By the late 1800s, runs were in decline, although still significant compared with today's levels (Romey et al. 2001). Clackamas River winter steelhead returns to North Fork Dam between 1963 and 2000 averaged 1,489 fish. A maximum return of 4,353 occurred in 1971, and a low return of 189 fish occurred in 1999. Returns have diminished in this decade and remain far below ODFW's annual escapement goal of 3,000 fish for the habitat above the North Fork Dam. Chilcote (1998) determined that the Oregon component of the LCR ESU has an unacceptably low capacity to survive future periods of environmental stress. The status of winter steelhead in the Clackamas River, which comprises a significant portion of the ESU, is a special concern to NOAA Fisheries (NMFS 2000b).

Literature Cited

The references for the citations in this appendix are included in Section 4 of the main document.

APPENDIX B - STUDIES TO RESOLVE CRITICAL UNCERTAINTIES

Water Quality
Alternatives analysis conducted by the Water Quality Subgroup (Subgroup) is being supported by activities that fall into three major categories: 1) Temperature Modeling, 2) Water Quality Modeling, and 3) Benthic Macroinvertebrates. These major categories, and their relationship to the remainder of the Fish And Aquatic Workgroup's efforts, are depicted in the *Alternatives Analysis Framework* (AAF) flowchart. These major categories and their subcomponents—also shown in the AAF—are described in the following paragraphs. These study elements are addressed in detail in the *Clackamas River Relicensing, Studies Tracking Report (STR)*.

Temperature Modeling (WQ1)
Temperature Modeling will be conducted using the CE-QUAL-W2 model, which will simulate various operating conditions throughout the year, thus estimating water temperatures relative to the range of existing and potential Project operations. Analysis will emphasize periods critical to salmonid life-stage development. Interactions of temperature on dependent water quality parameters will also be assessed. Water temperature data collected in support of CE-QUAL-W2 will also be summarized and presented as a characterization of existing conditions in the Project area.

Stream Shade Measurements were made as part of the Terrestrial Workgroup's riparian surveys. Results from these surveys were provided to the Subgroup for use in construction of the CE-QUAL-W2 model.

Water Quality Modeling (WQ2)
Water Quality Modeling (WQ2) will include both water quality and hydrodynamic components for the river and reservoir sections of the Clackamas River basin. The models can be used to estimate how water quality conditions will change in response to changes in management strategies, nutrient inputs, and other controlling factors. The modeling team will be able to specify the output time-step as dictated by the variable being addressed. The modeling team will work with the Fish and Aquatics Workgroup to identify modeling scenarios representative of various potential operational regimes. Development of these operational regimes will reflect the results and interpretations of the water quality studies as well as other study disciplines and Project engineering analysis. These various scenarios can then be modeled to describe the probable effects on water quality within the Project area and downstream in the Clackamas River.

The Toxins and Bioaccumulation study was undertaken to assess the direct and indirect effects of Project operation on the biological availability of toxicants in Project waters, with an emphasis on those addressed in ODEQ and Environmental Protection Agency water quality standards. Upon completion of a review of existing information on toxin sources, the Subgroup identified two substances—mercury and PCBs—that warranted further investigation. A two-tiered sampling approach is being employed to assess the concentrations of these toxins. The Tier-1 assessment is a reconnaissance level study that will determine the need to develop and complete a more intensive Tier-2 analysis. The purpose of a Tier-2 study, if needed, would involve more in-depth study of bioaccumulation PCBs or mercury, either resulting from or affected by Project operation, in sufficient detail to characterize the related human consumption and/or wildlife risk. Sampling of fish tissue for PCBs was completed in 2001. The results of PCB sampling indicate that PCB levels in large-scale sucker—selected for its benthic orientation and likelihood of taking up PCBs—tissue are below or similar to levels observed in other areas within the lower Willamette and Columbia river basins. Thus, no Tier-2 analysis will be required for this toxin. Sampling of mercury levels in rainbow trout tissue derived from Timothy Lake and North Fork Reservoir was completed in 2001. The Tier-1 evaluation will conclude when tissue analysis is completed for rainbow trout collected in Estacada Lake—scheduled for spring 2003. Data collected thus far do not indicate that mercury uptake in Project reservoirs is sufficient to warrant a Tier-2 investigation.

Benthic Macroinvertebrates (WQ3)
A longitudinal evaluation of Benthic Macroinvertebrates was conducted throughout the Project area from the tributaries of Timothy Lake through the Clackamas River downstream of River Mill Dam (to Carver Bridge). Sampling was conducted to meet the ODEQ Level-III assessment standard necessary to attain 401 certification. Knowledge gained through this study provides an overall indication of the biotic integrity of the aquatic environment within the Project area as well as in reaches upstream and downstream of the Project.

Supplemental Oak Grove Powerhouse Sampling was undertaken to specifically address differences in the macroinvertebrate community upstream and downstream of the Oak Grove Powerhouse. Sampling was conducted in equivalent margin habitats in both locations to assess whether flow fluctuation associated with Project operation appears to be influencing macroinvertebrate communities downstream of the powerhouse.

Sensitive Species Surveys were conducted in Project-affected waters and adjacent aquatic habitats for Federally-listed sensitive aquatic invertebrate species. The Columbia dusky snail, a Record of Decision, Survey, and Manage species, was found throughout the Oak Grove Fork and in the mainstem Clackamas from headwater tributaries downstream to the Faraday bypass reach. Populations appear to be quite secure throughout the basin. The distribution of several insect Species of Concern and several rare aquatic insects were encountered in higher elevation springs and spring channels that are not affected by Project activities.

Hydrology

Alternatives Analysis
The Fish and Aquatics Workgroup will consider the results of the hydrologic data analysis and use the operations model to evaluate the effects of various hydropower operations alternatives on the hydrology of the Project-affected reaches of the Clackamas River basin. (This operations alternatives analysis will be conducted in conjunction with analysis of the effects of alternative operations scenarios on various fish/aquatic resources, and the effects of alternative flow regimes on power generation.)

Effect of Hydropower Operations on Clackamas River Basin Hydrology
The purpose of this study is to analyze hydrologic data and develop an operations model to evaluate pre- and post-Project basin hydrology. This study forms the basis for the analysis of various Project operations alternatives with respect to potential effects on basin hydrology and affected resources. Components of this study include an Interim Hydrology Report and a series of supplemental hydrology reports, and an operations model. In addition, a separate but related analysis will evaluate the effects of alternative reservoir operations at Timothy Lake on aquatic and riparian resources around that reservoir.

Interim and Supplemental Hydrology Reports
The *Interim Hydrology Report* (January 2000 Interim Draft Hydrology Report) provides hydrologic information on the Clackamas River and Oak Grove Fork under pre-dam and existing conditions. Various hydrologic statistics were developed to obtain a better understanding of the hydrologic regime of the Clackamas River basin, and the report provides statistics on flow duration, flood-frequency, low-flow frequency, hourly hydrographs, etc. As requests for additional flow statistics or other specific hydrology-related information not embodied in this interim report have arisen, supplemental hydrology reports have been prepared to provide the requested information. The following supplemental hydrology reports have been issued to date: *Supplemental Hydrology Report* (June 2000); *Clackamas River Supplemental Hydrology Report 2* (March 2001); and *Clackamas River Supplemental Hydrology Report 3* (August 2001).

Operations Model
The operations model was developed as a tool to predict how proposed operating changes may impact river flows, reservoir elevation, and hydropower generation throughout the river system. The calibrated model has been completed. A description of the model and its underlying data/assumptions is provided in the *Draft Simulation Modeling Report* (March 2001). The model has been refined and will be used as needed for initial analysis of provisional operations alternatives to support development of final operations-related proposals.

Effect of Timothy Lake Operations
The purpose of this study component is to evaluate the effect of Timothy Lake water level operations on wetlands and riparian habitat and on tributary access from the reservoir. The evaluation entails field studies to characterize existing macrophyte beds and wetland/riparian habitat, and modeling to determine tradeoffs under alternative water level operations. Terrestrial vegetation and reservoir bathymetric surveys have been completed. Modeling efforts are pending identification of alternative reservoir management scenarios.

Alternatives Analysis
The Instream Flow/Geomorphology Subgroup (IFGSG) will consider the results from the various instream flow, hydrologic, and geomorphic studies to identify alternative flow regimes in the Project-affected reaches and the associated effects of the various alternatives on fish and aquatic resources and stream function.

Geomorphic Setting Summary
The *Geomorphic Setting Summary Report for the Mainstem Clackamas River and Oak Grove Fork of the Clackamas River* (February 2001) provides an analysis of existing information to describe hydraulic and geomorphic processes in Project-affected reaches, as well as a preliminary assessment of potential Project effects on aquatic/riparian habitat. It provides a set of preliminary hypotheses to be tested regarding: (1) physical processes that may be critical to channel morphology in the Clackamas River mainstem and Oak Grove Fork, particularly those that Project operations might have changed; (2) locations where morphological changes are likely to have occurred within the Clackamas River and Oak Grove Fork channel network; and (3) channel segments that may be more ecologically sensitive to Project operations.

Oak Grove Fork Instream Flow/Geomorphology Evaluation
This evaluation entails a collection of separate, but linked, studies to evaluate underlying channel geomorphic processes and flow-related effects on channel morphology/function, and riparian and aquatic habitat on the Oak Grove Fork. Components of this evaluation have been developed based on guidance from the IFGSG's Foundation Study Plan for the Oak Grove Fork.

Oak Grove Fork Foundation Study Plan
This working document (Officially titled: *In-stream Flow Issues and Considerations for Development of a Collaborative, In-stream Flow Study Proposal, Oak Grove Fork; Clackamas River* [latest draft July 2001]) was developed collaboratively by the IFGSG to outline the basic resource issues and study approach for the Oak Grove Fork instream flow/geomorphology evaluation. The Foundation Study Plan proposes hypotheses to be tested and identifies potential study methodologies. This document thus provides the foundation for development of more detailed study plans. Detailed study efforts to date include the following:

Preliminary/Reconnaissance Tasks For Instream Flow Studies
The Foundation Study Plan identifies several hypotheses that will be tested through one or more instream flow studies. To help determine the scope and areas of focus of the instream flow studies and to help select the most appropriate methodologies, a number of preliminary and reconnaissance investigations have been, or are being, conducted. These include:

- Off-channel habitat mapping (in coordination with the Terrestrial Resources Workgroup; completed 2001)
- Stream habitat mapping (completed 2001)
- Spawning gravel surveys (completed 2001)
- Pre-modeling demonstration flows in the lower Oak Grove Fork (October 2001)
- Technical review of existing IFIM study for the lower Oak Grove Fork (completed January 2002)
- Development of habitat suitability index curves (completed June 2002)

Oak Grove Fork Instream Flow Studies
Detailed evaluation of flow/habitat relationships in the Oak Grove Fork will be made through the following studies:

- Lower Oak Grove Fork empirical mapping - This study consists of habitat mapping conducted by a collaborative group of agency, NGO, and PGE biologists at a range of flows at two sites in subreach 1G (summer 2002).
- Lower Oak Grove Fork 2D modeling - This study consists of two-dimensional modeling of flow-habitat relationships at two study sites in subreach 1G by a USFS contractor.
- Instream Flow Studies will be conducted in subreaches 1B, 1D, and 1E upstream of Lake Harriet. The analysis method to be used is currently being identified by the IFGSG.
- Side channel habitat-flow relationships are being evaluated, and results will be used in conjunction with those from the empirical mapping study to assess the relationship between flow and anadromous fish habitat for the overall channel in subreach 1G.

Oak Grove Fork and Clackamas Mainstem (Reaches 2A and 2B) Initial Geomorphology Study
The Foundation Study Plan also identifies hypotheses regarding the Project's affect on channel morphology, sediment, and large wood transport, and other geomorphic processes and parameters of the Oak Grove Fork system. Reconnaissance-level analyses to address and refine these hypotheses (as well as corresponding hypotheses for the Clackamas mainstem above North Fork Reservoir) are being conducted in this initial geomorphology study (study plan dated August 13, 2001). Hypotheses will be revised/refined and more detailed geomorphic investigations will be conducted as needed, based on the results of these initial analyses.

Faraday Diversion Reach Reconnaissance Flow/Habitat Evaluation
A reconnaissance-level evaluation of the Project on riverine habitat and gravel/LWD distribution in this diversion reach was conducted in 2002, with results due in 2003. The evaluation will include observations of stranding of juvenile fish following spill over the Faraday Diversion Dam. Demonstration flows of 120 cfs and 240 cfs will be run to allow participants to observe the effect of higher flows on aquatic habitat in this reach. In addition, a sediment retention analysis will be conducted using existing transects in this reach; this analysis will include calculation of transport capacity and evaluation of historic hydrologic record to describe the likelihood of gravel staying in channel over time.

Clackamas River Mainstem above North Fork Reservoir (Reaches 2A and 2B) Reconnaissance Flow/Ramping Study
This study is a reconnaissance-level analysis to evaluate the magnitude of operations-related stage change and ramping effects and the potential significance of these effects to aquatic/riparian habitat and biota on the Clackamas River between the Oak Grove Fork confluence and North

Fork Reservoir. The study plan (dated August 2001) outlines the first phase of the study approach for evaluating instream flow issues in this reach. The studies in this plan are primarily reconnaissance level and are designed to test a number of hypotheses on how Project operations may have affected aquatic and riparian resources within the Project area and downstream. The reconnaissance-level studies will provide information necessary to determine which, if any, of the hypotheses require more in-depth studies to fully define Project effects.

Lower Clackamas River Geomorphology Study
This study is an evaluation of the geomorphic and hydraulic processes over the last 90+ years from River Mill Dam to the mouth of the Clackamas River. It will also evaluate sediment supply changes over this time period and the response of the river channel and bed characteristics to these changes. In conjunction with this study, two other study aspects were underway in 2002: (1) evaluation of geomorphologically induced changes to aquatic habitat (e.g., side channels), and (2) a pilot gravel augmentation study.

Fish Passage
Alternatives analysis conducted by the Fish Passage Subgroup (Subgroup) is being supported by activities that fall into four major categories: 1) Mainstem Clackamas Upstream Passage alternatives, 2) Mainstem Clackamas Downstream Passage alternatives, 3) Existing Information Analyses, and 4) Oak Grove Fork Cutthroat Trout Population Status. These major categories, and their relationship to the remainder of the Fish and Aquatic Workgroup's efforts, are depicted in the AAF flowchart. Each of these major categories comprises a number of components—also shown in the AAF flowchart—which are described in the following paragraphs. These component parts can sometimes be further broken down into individual studies that are addressed in detail in the *Clackamas River Relicensing, STR*.

Upstream Passage
- Mainstem Clackamas Upstream Passage Facility Engineering activities have thus far included conceptual designs for a fish ladder at River Mill Dam.
- Fish Studies have been conducted to address issues associated with upstream passage. The Subgroup identified potential Project-related delay of upstream migrating adult salmonids as an issue requiring investigation. To address delay, Adult Coho Telemetry Studies and Adult Steelhead Telemetry Studies have been conducted with adult early-run coho salmon (2000) and adult winter steelhead (2001), respectively. Follow-up studies, following modifications to the North Fork fish ladder, are planned for 2003 with steelhead and possibly late-run coho.
- The River Mill Fish Ladder Statement of Facts Established was formulated by the Subgroup to acknowledge that the existing River Mill fish ladder was inadequate for upstream passage and to forego the need for biological studies to confirm the ladder's inadequacy in favor of allocating funds toward improvements of the facility.
- The River Mill Tailrace Physical Model was developed to identify optimum locations of the new River Mill fish ladder entrance and juvenile bypass outfall and to investigate alignment for a potential tailrace fish guidance structure. A demonstration of the model to

the Subgroup was conducted in October 2002 and video documentation of each potential facility change, over a range of flows, will be provided in winter 2002/2003.

Downstream Passage

- Mainstem Clackamas Downstream Passage Facility Engineering includes the development of conceptual alternatives for the three mainstem PGE Projects: North Fork Dam, the Faraday Complex, and River Mill Dam. For each facility, conceptual designs have been developed ranging from screening systems that conform to regulatory agency guidelines to experimental technologies.
- One potential experimental approach to fish passage at North Fork Dam is the operation of a barrier net in the forebay. PGE engineering, in conjunction with its contractors, initiated a Barrier Net Feasibility Analysis to ascertain whether such an approach would be practical. This analysis was postponed until further notice during fall 2001.
- Fish Studies have been conducted to address issues associated with downstream passage:
  —The Timothy and Harriet Lakes Entrainment Studies began in fall 2000 to address fish entrainment at these facilities. These studies continued through fall 2002.
  —In spring 2001, the Subgroup undertook the North Fork Juvenile Bypass Evaluation to assess smolt migration rates and the extent of injury and descaling to smolts in the existing bypass from the intake in North Fork forebay to the pipeline outfall in River Mill tailrace. This study, with minor modifications, was repeated in spring 2002.
  —Sonic tags were used in the spring 2001 North Fork Reservoir Chinook Smolt Behavior Study to track the movements of chinook smolts as they approached North Fork Dam to determine if they migrated deep in the water column and were potentially being entrained in the turbine intakes.
  —To identify exit route selection of smolts from the North Fork forebay, the North Fork Reservoir Smolt Exit Route Studies were initiated in spring 2002. Chinook, steelhead, and coho smolts were being radio-tagged and tracked in and downstream of North Fork Reservoir during spring 2002, and chinook smolts were being tracked in fall. During the fall study, a partial forebay barrier net is being evaluated in terms of its effectiveness to improve efficiency of the existing bypass structure.
  —The North Fork Chinook Controlled Spill Study is being conducted in fall 2003 to evaluate the effect of a single spill level on guidance of fall-migrating spring chinook smolts into the existing downstream bypass system with 600 cfs bypass flows, with and without a barrier net in place.
  —The Chinook Tagging/Handling Effects Study was conducted in fall 2002 to evaluate the effects of radio tagging, PIT-tagging, and associated handling on wild spring chinook smolts under controlled conditions. Results will be used to account for handling-related mortality when evaluating the results of the exit route and controlled spill studies.
  —To assess whether a regulated spill over the Obermeyer weir on the River Mill spillway is a viable option for downstream smolt passage the River Mill Spillway Telemetry/Smolt Passage study was conducted in 2001. During spring 2002 the study was repeated, with alterations to the Obermeyer weir to simulate the effect of spillway modifications currently under consideration. In spring 2003, the study will be conducted once more to

assess whether construction of a bypass conduit between the turbine intakes and the modified Obermeyer weir.
—A balloon-tag study was undertaken in 2001 to evaluate the North Fork Spillway Passage Survival of smolts under two different spillway flows.

- Modeling is being conducted to evaluate potential designs for new facilities and to assess the fate of downstream migrants under proposed system alternatives.
  —To conduct a preliminary evaluation of system-level passage alternatives (i.e., combinations of individual facility alternatives) improvements have been made to an existing Downstream Migrant Mortality Model for the Clackamas River Project reach. Model runs are currently underway to evaluate proposed system-level passage alternatives for the Project area.
  —The River Mill Tailrace Physical Model is explained above under *Upstream Passage Alternatives*.

Existing Information Analyses

- The Fish Passage EIA was completed to summarize the results of studies and existing information relevant to upstream and downstream passage at various Project components and make recommendations regarding additional studies needed to more fully address specific passage issues.
- The Subgroup identified the need for a more thorough understanding of the performance of screens and bypass facilities designed to conform to standardized criteria established by NOAA Fisheries. The *NMFS Criteria Screen Performance EIA* was completed in March 2002 to evaluate the performance of facilities comparable in size to what would be required on the Clackamas River if a criteria screen alternative were chosen.

The following studies are not shown in the AAF, but are included in the *Clackamas River Relicensing, STR*:

- Continuation of field counts of spring chinook below Oak Grove Powerhouse (upstream passage)
- Faraday spillway passage survival (downstream passage)
- Fry migration into and survival in North Fork Reservoir, PIT-tag data (downstream passage)
- Existing PIT-tag data evaluation (downstream passage)